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A Summary of Current Program, 10/1/67 —
and Preliminary Report of Progress
for 10/1/66 to 10/1/67

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FARM PRODUCTION ECONOMICS DIVISION
of the
ECONOMIC RESEARCH SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE
and related work of the
STATE AGRICULTURAL EXPERIMENT STATIONS

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CURRENT SERIAL RECORDS

This progress report is primarily a tool for use of scientists and administrators in program coordination, development and evaluation; and for use of advisory committees in program review and development of recommendations for future research programs.

The summaries of progress on USDA and cooperative research include some tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed, will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to members of Department staff, advisory committee members and others having a special interest in the development of public agricultural research programs.

This report also includes a list of publications reporting results of USDA and cooperative research issued between October 1, 1966, and October 1, 1967. Current agricultural research findings are also published in the ERS publications The Farm Index, a monthly, and Agricultural Economics Research, a quarterly. This progress report was compiled in the Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture, Washington, D. C. 20250.

UNITED STATES DEPARTMENT OF AGRICULTURE
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INTRODUCTION

Farm production economics research, as used in this report, deals with many and varied economic problems of agricultural production. The work is concerned with the economics of organization and management of farms and the agricultural supply industry, use of capital and labor in agriculture, adjustments in production and resource use, and appraisal of alternative production policies and programs. First priority attention is given to those problems with nationwide, regionwide, commodity-wide or resource-wide implications.

A continuing major problem in agriculture is the adjustment of production, both in the aggregate and for major commodities, to market outlets. Achievement of economic balance in agriculture and adequate returns to farmers is likely to continue to be difficult over the next 5 to 10 years as we strive to match the increasing capacity of agriculture to produce with the food and fiber requirements of a larger U. S. population and expanding outlets for exports and Food for Freedom programs. Farms are decreasing in number and increasing in size and degree of specialization. Farm machinery, fertilizers, and other innovations, are substituting for land and labor. Coupled with rising farmland values, these developments necessitate large and increasing capital investments per farm, and alter farm credit and insurance needs. Increasing dependence on purchased inputs and on cash markets for products make net income increasingly vulnerable to changes in prices of both inputs and outputs. These trends together with emerging problems in farm labor challenge the most rigorous research in the field of farm economics. Results of research in this field are widely used as aids in management and policy decisions at the farm, area, regional, State, and national levels.

The Department's program of research and related statistical reporting in farm production economics is conducted from headquarters in Washington, D. C., and is concerned chiefly with problems of regional and national scope. Field studies generally are conducted in cooperation with State experiment stations. When studies are made jointly by Federal and State workers, Federal people usually are most interested in regional and national applications of results, while State workers are most often interested in local applications. Close working relationships between Federal and State agencies have long been traditional in this field. This close cooperation in planning and conducting the work reflects joint and cooperative efforts rather than overlapping or duplication of effort.

The farm production economics research program is covered under 9 area headings shown in the Table of Contents. More detailed subject-matter subheadings are given in the discussion of each area of work.

During the year covered by this report, the special policy and program contributions that the Division has been able to make have been significant. Division personnel have responded to many requests for assistance from the Office of the Secretary, program administrators, Members of Congress, and others. In addition, many of the Division's continuing statistical series and analyses have become increasingly important in efforts to understand changes and achieve improvements in the structure and in the well-being of American agriculture.

Some illustrative examples of Division research contributions during the reporting period follow.

Comprehensive Study of Economies of Size in Farming Completed. During the reporting year, the Division completed and published a comprehensive analysis of the economies of size in farming. The analysis included cash-crop farms in Iowa and California; wheat farms in Oregon; irrigated cotton farms in Texas and California; dairy farms in New England, Iowa, Minnesota and Arizona; and beef feedlots in Colorado, Oregon and California. In most crop-farming situations, it was found, all the economies of size can be achieved by modern, fully mechanized 1-man or 2-man farms. Such farms are capable of employing the standard power units and machines generally in use on large farms, which in effect are multiples of the smaller farms. In the case of Iowa dairy farms, most of the economies of size are attainable by a 40- to 50-cow dairy. The Minnesota 1-man dairy farm could realize little if any increase in efficiency by doubling its size and hiring an additional worker. In the case of cattle feedlots, the technical economies of size were not important above a moderate size, say 1,500- to 5,000-head capacity. The small technical differences among large lots easily could be offset by small differences in feed costs, which are achievable by good "shoppers."

Although the full-time, 1-man and 2-man farms are highly efficient, it is often possible for them to increase total profit by extending beyond the most efficient size. In such cases the incentive for expansion is higher total profit rather than lower average unit costs.

Supply-Price Relationships in Southern Rice Producing Areas Analyzed. The Farm Production Economics Division and the agricultural economics departments of the Arkansas, Louisiana, Mississippi and Texas Experiment Stations completed a cooperative regional research project to determine the supply-price relationships for rice assuming no production control programs for rice or cotton. It was also assumed that farm operators would seek to maximize profits on owner-operated units which in size and kinds of resources are representative of modal groupings of farms in the major rice areas. Optimum enterprise combinations were based on input-output coefficients that reflect practices carried out by the more efficient farmers.

The overhead or fixed costs for equipment and related investments reflect an assumed intermediate planning period that is representative of usual replacement practices. Estimated returns from enterprises were based on prices assumed to reflect the projected long-run supply-demand equilibrium level. To obtain an indication of the probable supply response for rice to changes in prices received, the average price for rough rice was varied from \$2.30 to \$4.00 per 100 pounds.

The major rice areas in the Southern States encompass some 11.3 million acres of total cropland, of which 8.5 million acres are well suited to the growing of rice in rotations. Availability of water for irrigation and/or agronomic limitations set the potential annual acreage of rice at approximately 3.6 million acres. Should the potential be reached, some 1.2 million acres or 34 percent would be in the Mississippi River Delta, 0.9 million acres or 25 percent in Southwest Louisiana, 0.8 million acres or 22 percent in the Grand Prairie and Northeast Arkansas areas, and 0.7 million acres or 19 percent in the Coastal Prairie area of Texas.

With competing enterprises priced at projected long-run equilibrium levels, and assuming that farmers react according to the assumptions imposed, only about 279,000 acres of rice would be grown when rough rice is priced at \$2.30 per 100 pounds. This acreage would be in the Southwest Louisiana area and the Coastal Prairie area of Texas where alternative enterprises are most limited. A rise in price through \$2.65 per 100 pounds would bring in additional acreages at a gradual rate. However, between rice prices of \$2.65 to \$2.75 per 100 pounds a marked expansion would occur. This 10-cent range would double the rice acreage, with plantings at about 1.6 million acres, or 45 percent of the potential acreage that can be grown in the Southern States, and at 116 percent of the 1964 acreage. A price of \$4.00 per 100 pounds would bring forth about 3.3 million acres, or about 92 percent of the potential acreage in all study areas.

Additional rice acreages, brought into the optimum programs by higher rice prices received, had a greater effect on the acreage of soybeans grown in these areas than on any other competing enterprise. While other enterprises were reduced by moderately small percentages with a change in rice prices from \$2.30 to \$4.00 per 100 pounds, the acreage of soybeans was decreased from 2.9 million to 1.0 million acres.

Raising the price of competing enterprises to near the "current" level made it necessary that rice prices be raised, but not in a direct ratio, to bring about similar adjustments between enterprises as when the equilibrium level of prices was used. With soybean prices at \$2.50 per bushel instead of \$1.80, the range in rice prices at which marked adjustments between these enterprises occurred was changed from about \$2.70 per 100 pounds to about \$3.00

Changing Costs of Producing Upland Cotton Measured in Three Belt-Wide Surveys. Three belt-wide enumerative surveys in major cotton regions were conducted, covering costs of production in 1964, 1965, and 1966. These surveys are to aid in guiding the Department's special research programs to reduce the cost of producing Upland cotton and to allow the Secretary to consider changes in production costs in establishing price support levels. The results of the first and second surveys have been published. Data for the third are being processed.

The total cost of producing the U. S. crop of Upland cotton in 1965 was 27.3 cents per pound of lint, compared with 28.4 cents in 1964. About 73 percent was produced at a total cost of less than 30 cents per pound in 1965, compared with 64 percent in 1964. These costs include market rates of return to all inputs used except unpaid management. The one-cent decline in cost per pound in 1965 was due chiefly to higher yields; a decline in labor inputs, especially hand harvesting, also contributed. Labor costs per acre harvested in 1964 totaled \$42 and dropped to \$37 per acre in 1965; per acre costs of most other inputs increased. Power and equipment costs per acre harvested increased from \$34 in 1964 to \$37 in 1965. About 85 percent of the 1965 crop was machine harvested as compared with 76 percent of the 1964 crop.

Estimates of total cost per pound of lint in 1965 ranged from 24.7 cents in the Mississippi Delta region to 34.9 cents in the Upper Rio Grande-Trans Pecos region of Texas and New Mexico. Total costs per pound of lint averaged less than 26 cents in 5 regions: The Mississippi Delta, Southern California and Southwest Arizona, the Coastal Prairie of Texas, the High Plains of Texas, and the Rolling Plains of Texas-Oklahoma. Total costs in these 5 regions ranged narrowly from 24.7 cents to 25.3 cents per pound of lint in 1965. The first 3 regions listed above were among the 4 lowest-cost regions in 1964.

Farmers Use Forty Percent of Pesticides. Preliminary estimates from the Nationwide Pesticide Survey conducted in early 1965 show that although chemical pesticides are used by nearly all U. S. farmers, the quantity used on farms in 1964 was only about 40 percent of all pesticides produced in the U. S. that year. The remainder was used by industry, Government, and homeowners or was exported. In terms of expenditures, farmers nearly tripled their purchases of pesticides from 1954 to 1964.

Preliminary indications are that farmers used about 458 million pounds (technical basis, 100 percent active materials) of specially formulated chemical products to control crop and livestock pests in 1964. In addition, they used about 313 million pounds (approximately 4.5 million gallons) of petroleum, primarily as a pesticide, but to some extent also as solvents and mixing agents.

The major share of the pesticides was used on crops -- about 93 percent by weight of the technical ingredients. Livestock accounted for 3 percent; other uses, for 4 percent.

Although over 10,000 individual commercial products are used as pesticides, these are mostly different formulations, concentrations, and combinations of about 250 technical or basic pesticide products. For example, 2 technical herbicide ingredients accounted for 55 percent of the pesticides used by farmers in 1964; 6 insecticide ingredients, for 75 percent of the insecticides used; and 3 fungicide ingredients, for about 60 percent of all fungicides used by farmers.

Fungicide products for agricultural use amounted to 170 million pounds of technical materials in 1964, of which 80 percent was sulfur. Fungicide use was concentrated on cotton and on fruits and vegetables.

Farmers used 84 million pounds of herbicides in 1964, or slightly over 50 percent of total use in the U. S. The Corn Belt was the leading herbicide-using area. Most of the herbicides (nearly 60 percent) were used on corn and small grains.

Insecticides are the major pesticide products used by farmers in terms of both pounds of material applied and dollars spent. Trends in farm use are not available, but total insecticide production has increased about 5 percent a year in recent years. Farm use in 1964 accounted for 156 million pounds or about 40 percent of total U. S. insecticide production for that year.

The most commonly used insecticide products were toxaphene -- 39 million pounds -- and DDT -- 32 million pounds. These two products accounted for 45 percent of all insecticides (not including petroleum) used by farmers. Ninety-two percent of the insecticides were used on crops, and over half of the insecticides used on crops were applied to cotton.

Below are some illustrative examples of research reported by State Experiment Stations.

Size of Farm Affects Long-Term Debt Repayment Capacity. The larger size farm units have substantial advantages over smaller size farms in long-term debt repayment capacity, finds the Texas Agricultural Experiment Station. The debt repayment capacity per acre for a 960-acre farm ranges from about two to over six times that of a 240-acre farm, depending on the assumptions made. Higher production levels and better management practices reduce the per acre differences between large and small farms. With only average production for cotton (200-pound yield, lint), current prices and Government programs, the operator of a 240-acre farm would have dubious

prospects of repaying a real estate mortgage, particularly if he also had non-real estate debt obligations. On a 960-acre farm, the maximum amount that an operator would be able to repay with a 35-year loan would be \$125 per acre if he was an average manager and \$159 per acre if he was an above average manager, assuming he carried no short- or intermediate-term debt. On an average size farm (480 acres), the maximum loan that an operator would be able to repay with a 35-year loan would amount to \$90 and \$119 per acre, respectively, for average and above average management, while for a 240-acre farm it would amount to \$37 and \$62 per acre respectively.

If allotment restrictions were removed and cotton prices were free to seek equilibrium levels, the area prices for cotton in 1975 might average about 19 cents per pound, lint. At a price of 19 cents per pound and with no allotment restrictions, long-term debt repayment capacity would be substantially below repayment capacity under the 1964 program. If no expenses for non-real estate debt servicing are assumed, the amount of reduction would range from 28 percent for a 240-acre farm to 19 percent for a 960-acre farm. If, however, equilibrium prices under free market conditions should average 21 cents per pound, repayment capacity would be about equal to what it was under the 1964 program. Indications are that repayment capacity under free market conditions would be highly sensitive to small fluctuations in cotton prices.

All-Risk Crop Insurance Studied in North Dakota. The role and operations of all-risk crop insurance in North Dakota was investigated by the North Dakota Experiment Station. An index of crop production risk for each county was prepared. These risk indices delineated the State into three areas of similar patterns of variation in crop yields. A survey was conducted to ascertain the "demand" for insurance by farmers and to determine organization and institutional factors affecting farmers' use of all-risk crop insurance. It was found that participators operated the largest farms and/or controlled the most resources in the low- and medium-risk areas. However, in the high-risk areas, the nonparticipators operated the largest farms and/or controlled the most resources. Participators in the low- and medium-risk areas preferred to transfer part of their risks to insurance companies, whereas nonparticipators in the high-risk area preferred self-insurance. In all areas, spatial diversification was a technique used by nonparticipators to avert risks in crop production.

Generally, participators said that they carried all-risk crop insurance to protect their operating expenses, while nonparticipators said the coverage was too low to cover operating expenses and the chances of collecting an indemnity were too remote. The annual crop yields and production expenses per acre were about the same for farms operated by both participators and nonparticipators. When farmers selected the coverage (price per bushel) needed to cover operating expenses on their farms,

nonparticipants usually selected the medium- or high-price options, while participants selected the medium- or low-price options, indicating that nonparticipants wanted to insure some income in addition to operating expenses.

Both participants and nonparticipants indicated little interest in insurance programs for gross income, pasture, hay, and livestock. Also, an all-risk crop insurance based on the average county yield was rejected because farmers felt the premiums would be too high. Farmers showed considerable interest in insuring separate tracts of land, either each field or each quarter section.

Changing Agriculture Required More Credit. Beginning farmers need more than three times as much capital today as they did 15 years ago for an average farm operation, a study by the Tennessee Experiment Station indicates. These tremendous capital requirements have placed a burden on many farmers and added responsibility on the agricultural lending institutions.

More than 70 percent of the commercial farmers in Middle and West Tennessee used farm credit. Several factors influenced whether or not a farmer borrowed. Owners used credit less often than part-owners and tenants. Cotton farmers used credit more often than livestock, tobacco, and general farmers. Farmers in their thirties used credit more often than did any other age group; thereafter, as age increased, the percentage of users decreased. Farmers with large acreages more often used both operating and real estate credit than farmers with small acreages. As total cash receipts increased, the percent of farmers using farm credit increased. There was no definite relationship of a farmer's net worth, total farm investment, or net farm income with whether he did or did not use farm credit.

About 46 percent of the loans were for operating expenses; 26 percent for livestock or equipment purchase; and 22 percent for real estate purchase or improvement. The remaining 6 percent were for family living. Chattel mortgages were most often used to secure loans -- 44 percent. About 26 percent of the loans were secured by real estate mortgages; 16 percent by promissory notes; and 14 percent had no formal security.

Florida Station Studies Labor-Saving Equipment in Fruit and Vegetable Production. The Florida Experiment Station reports that increasing costs of labor give an added impetus to the advantage gained from the use of labor-saving equipment by southern fruit (non-citrus) and vegetable producers. The Station found that machine picking for fresh market beans required about 45 hours of man labor per 1,000 bushels compared with 1,070 hours for hand picking. Machines left no more mature beans unharvested than hand pickers, and the labor requirements for grading and packing were the same for mechanical and hand harvesting. Mechanical harvesting of beans

for processing required only 60 percent as much labor per acre as mechanical harvesting of beans for fresh market. Sweet corn harvesters did the work of 18 to 25 hand pullers, but some labor saving was lost due to extra work by packers in removing pieces of stalk attached to the ears. A celery cutting machine as an adjunct to a conventional mobile harvester operated successfully, but with no saving in labor. The avoidance of stoop labor was a distinct advantage and permitted use of women workers.

AREA NO. 1. AGRICULTURAL ADJUSTMENTS, PRODUCTION
RESPONSE AND FARM PROGRAM APPRAISAL

Problem. A chronic major problem in agriculture is to adjust production, both in the aggregate and for major commodities, to market outlets. Achievement of economic balance in agriculture and adequate returns to farmers is likely to continue to be difficult over the next 5 to 10 years as we strive to match the increasing capacity of agriculture to produce with the food and fiber requirements of a larger U. S. population and expanding outlets for exports and Food for Freedom programs. Some resources now used in lines of production that are either over-expanded or in short supply need to be shifted. Individual farmers can reduce costs per unit of product by reorganizing farm enterprises, adopting improved technology, and increasing the size of their farms. But when many farmers do this, total output mounts and the problem of bringing total supply in line with total demand is intensified. Thus adjustment opportunities cannot be considered solely from the viewpoint of the individual farmer. National and regional aggregate production response are important in considering the farm adjustment problem. Analyses of profitable adjustments on representative farms and estimates of both the aggregate output that would be forthcoming if all farms were efficiently organized and operated, and the aggregate response that farmers would be expected to make, are needed as a basis for evaluating the adjustments that would be profitable both to individual farmers and to the industry under different economic situations, and for appraising the effects of alternative farm adjustment programs. Continuing analysis of trends in farm output and resource productivity is also needed to measure changes in the farm situation.

USDA AND COOPERATIVE PROGRAM

The program encompasses 4 major types of work. Studies of national and regional productivity conducted in Washington, D. C. analyze the factors responsible for changes in total output and resource productivity for the Nation and for 10 broad farm production regions. These studies become the basis for long-term projections of prospective trends in farm output and productivity, in numbers of farms, and in other major characteristics of the Nation's agriculture. Studies of production response and needs for adjustment are conducted in Washington, D. C. and at several field locations. These studies emphasize the methodological developments required to appraise the production response farmers are likely to make individually and in the aggregate to changes in technology, costs, product prices, Government programs, and other factors. Attention is also given to the optimum (least cost) regional distribution of crop and livestock production. Area adjustment studies in dairy, cotton, wheat, rice and feed-livestock areas emphasize the determination of the most profitable adjustments for representative farms to alternative combinations of

prices. The most profitable organizations, weighted by the proportion of the total number of farms represented by each typical farm, provide first approximations of the area implications of individual farm adjustments.

These studies are conducted in cooperation with 14 State Experiment Stations in dairy areas, 16 in cotton areas, 11 in wheat areas, and 17 in feed-livestock areas. Studies of adjustment opportunities in rice areas are conducted in Arkansas, California, Louisiana, Mississippi, and Texas. Studies of agricultural policies and program appraisals are oriented toward an understanding of the impacts and means of improving programs and policies at the national level, including the acreage allotment programs, wheat programs, prospective use of land released from the Conservation Reserve, and impacts of the current feed grain program.

A total of 62.0 Federal scientist man-years are devoted to this area of work: 2.2 man-years to national and regional productivity in agriculture; 20.6 man-years to appraisal of production response and needs for adjustment; 4.0 man-years to appraisal of adjustments in dairy areas; 7.9 man-years to adjustments in cotton areas; 6.8 man-years to adjustments in wheat areas; 4.0 man-years to adjustments in rice areas; 7.6 man-years to adjustments in feed-livestock areas; 1.8 man-year to appraisals of agricultural policies and programs; and 7.1 man-years to cotton cost analysis.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 57.0 scientist man-years is devoted to this area of research.

PROGRESS -- USDA AND COOPERATIVE PROGRAM

A. National and Regional Productivity in Agriculture

Preliminary estimates of 1967 total farm output indicate a 4-percent increase from 1966 to a record level of 18 percent above the 1957-59 average. Total livestock production, also a record, is 1 percent greater than in 1966. Production of meat animals and of dairy products will be the same as in 1966, but production of poultry products will set a new record, 6 percent above 1966. Total crop production in 1967, also a record, is expected to be 4 percent above the 1966 production. Cropland used for crops is 4 percent greater than last year and the largest since 1960. Crop production per acre equals the record of 1965. Feed grain production is 12 percent greater than in 1966; record production of both corn and sorghum grain more than offset below-average crops of oats and barley. Food grain production is 15 percent greater than a year earlier, with record production of wheat and rice. Oil crop production in 1967 is at a record level, 76 percent above the 1957-59 average. The first billion-bushel soybean crop is expected in 1967. Cotton production is expected to be the lowest in 46 years because of the 11-percent reduction in acreage from 1966 to 1967 and the lowest yield since 1962.

Total inputs used in farming in 1967 are expected to be 2 percent above the 1966 level. Farm output per unit of input is nearly 2 percent greater than in the previous year, but 2 percent less than the 1965 record. Farmers in 1967 continue to use record quantities of nonfarm inputs. For example, farmers have continued to increase their purchases of fertilizer. In large part, past increases in nonfarm inputs have been offset by a reduction in the quantity of labor used on farms.

Reappraisals of prospective increases in crop yields indicate that average yields by 1980 may equal 110 bushels of corn, 76 bushels of sorghum grain, and over 6,000 pounds of rice. These yield increases are expected as farmers increase the use of improved seeds, fertilizer, narrow-row spacing, and other improved practices. (Average yields in 1966 were 72 bushels of corn, 56 bushels of sorghum grain, and 4,320 pounds of rice.)

A pilot study analyzing the effects of weather and technology on crop yields, being conducted jointly with the Iowa Experiment Station, was initiated. This research program is limited in scope to a few crops in a few States, namely corn in Iowa and Illinois; wheat in Kansas, Nebraska, and North Dakota; and grain sorghum in Kansas and Nebraska. Data on crop acreage, crop production, fertilizer application rates, varietal improvements, and weather variables have been collected. The data for corn in Iowa were analyzed using regression techniques to determine the feasibility of the methodology. Preliminary analysis of the Iowa data has shown that the weather variables used explain a significant portion of the historical variation in yields. Fertilizer variables have likewise explained significant amounts of variation, but the shape of the aggregate response curves developed has not been entirely satisfactory. The analysis has provided support for the hypothesis that corn yields are less sensitive to variations in weather than was the case 30 years ago.

B. Appraisal of Production Response and Needs for Adjustment

Progress continued in the development and testing of a "national model" for production adjustment research and policy guidance. A 5-year test (1960-1964) of the model's ability to predict changes in the acreage of major field crops one year ahead was completed. The 95 aggregate resource situations (units of analysis) in the national model accounted for the following average percentages of U. S. crop acres during the test period.

<u>Crop</u>	<u>Percent included in model</u>
Cotton, upland-----	86
Wheat-----	84
Corn-----	85
Barley-----	68
Grain sorghum-----	82
Soybeans-----	87

Test results for the above crops are summarized in the following table.

Average deviation of model acreage estimates from reported actual data,
ignoring sign; 1960-1964

Crop	South- east	South Central	West	Great Plains	North Central	Total
	-----Percent-----					
Cotton, upland---	7.8	0.6	2.2	---	---	1.0
Wheat-----	38.4	8.6	2.6	3.0	12.6	4.2
Corn-----	6.6	10.0	---	8.6	16.4	14.6
Barley-----	---	---	3.0	4.8	21.4	3.4
Grain sorghum---	---	7.2	11.4	19.4	37.4	15.8
Soybeans-----	8.0	2.4	---	50.6	7.6	6.8

The average percentage deviation of acreage estimates from actual acreages, for the model as a whole, ranged from 1 percent for cotton to 16 percent for grain sorghum. However, there were offsetting errors in the results for area groupings shown in the table, as well as among regions within each area.

Rather than continue the model development and testing on an historical basis, it seemed necessary at this point to orient the research more to analyses of response before-the-fact. Thus the model was updated -- and minor revisions made -- for analyses of selected policy questions pertaining to the 1968 crop year. These analyses involve estimating 1968 acreage response, resource use, and related variables under the following conditions:

A. Benchmark analysis

1. A continuation of 1967 Government supply programs for cotton, wheat, and feed grains.
2. 1967 product prices.
3. Expected trend changes in yields, costs, and technical coefficients.

B. Analysis of response under alternative Government supply programs
(Various changes in price support payments, diversion limits and payments, diversion limits and payment rates, and allotments.)

The 1968 test, to be completed shortly, will provide a more meaningful basis for evaluating the usefulness of a formal mathematical model in helping to provide the economic intelligence needed for policy decisions.

Work was essentially completed on a study of "aggregation error" in linear programming analyses. A procedure for defining representative farms so as to minimize potential errors of aggregation was tested on a sample of farms in the Southern Coastal Plains. The test showed that, when results were compared with error from conventional grouping according to farm size, the new procedure reduced aggregation error significantly. The test also showed that aggregation error was minimized by using activity coefficients that were weighted averages of comparable coefficients for all farms grouped together.

A related cooperative study with the Iowa Experiment Station was completed. The study showed that in linear programming models of production containing many activities and resource restraints, the aggregate results obtained from analysis of representative farms do not have a predominant direction of error. As aggregation errors diminish in magnitude as more representative farms are specified, the choice of the number of units for a given analysis must take into account the additional research costs of including more farms. The study also suggests that different sets of representative farms may be required to accurately estimate the aggregate production of different commodities.

A method of relating aggregate supply response to the response of individual farms is currently being examined in cooperation with the Indiana and Iowa Experiment Stations. Both studies use a State linear programming model containing representative farms, regional input supply functions, and resource transfer activities. These studies are concerned with developing a regional supply model that permits both inter- and intra-farm resource adjustments. The Purdue model includes special programming restraints to simulate the adjustment behavior of individual farms over time. The Iowa study is using data from the 1964 and 1966 ERS Pesticide Use Surveys, and from a survey sponsored by Iowa State University, to isolate and quantify resources on representative farms.

Further progress was made on studies of interregional competition in U. S. crop and livestock production, in cooperation with the Iowa Experiment Station. A workable quadratic programming model was developed and a solution obtained for a trial problem. Nearly all the technical coefficients have been obtained for another programming model which includes more intraregional detail than was possible in earlier interregional models.

C. Appraisal of Adjustments in Dairy Areas

The milk supply functions for representative farms in the Northeast have had considerable application during the year. They represent production that would be profitable on dairy farms, assuming the technology levels of the top 25 percent of the farmers in 1960. It is estimated that this technology level will represent average dairymen of 1970.

In Connecticut, a regional spatial equilibrium analysis for the Northeast was conducted, which included 12 Northeast areas and one outside area with Chicago as its center. Demand functions were estimated by linear approximation from secondary sources. Supply functions were derived from the Northeast dairy supply function data. Transportation costs were tabulated from mileage information. A comparative statics approach was taken with the equilibrium points set at 1965 and 1970. Projections of the shifts of demand and supply to 1970 were estimated by linear trend analysis. The spatial equilibrium solutions were obtained by quadratic programming based on the Takayama-Judge model. Three alternative market pricing conditions were tested -- perfect competition, fixed differential pricing, and monopoly. One journal article and one Ph. D. thesis were completed. One bulletin is in progress.

In New Hampshire, these normative supply functions were combined to estimate aggregate supply for the Northeast with production resource bases of 1960 and 1965 with and without historical price differentials. Demand was estimated and related to supply, and a price-quantity disappearance curve reflecting classified pricing was developed. The results of this aggregation and equilibrium analysis are being combined in a publication which also discusses research methodology used in the Northeast study with particular emphasis on the problems associated with the micro to macro research approach.

Pennsylvania and New Jersey have used the area stepped supply functions in several spatial equilibrium models for the Northeast. Results of these models are now being analyzed with emphasis on the competitive relationships between the areas. Research was also conducted in the general area of developing and testing the predictive qualities of several aggregate milk output response models for a 15-county area. Three synthetic type output response models were developed and used to estimate 1965 area milk production and farm resource use. The models were (1) a linear programming model, (2) a recursive programming model, and (3) a linear programming model in combination with the Markov chain technique to project farm resource bases. Flexibility restraints in the recursive programming model limited the year-to-year rate of off-farm movement of labor and the expansion of silo capacity and dairy housing. Estimates of 1965 area milk output from the Markov chain-linear programming combination model were lower than reported production, even at very high milk prices. Changing the level of forage crop yields in the linear programming model had very little effect on predicted milk output. But estimates of milk output were quite

responsive to changes in the level of the dairy labor requirement. Synthetic estimates of 1965 area milk output based on a dairy labor requirement of 111 hours per year for a cow and her share of a replacement animal were the better predictors of 1965 area milk production. Estimates based on a more efficient 77-hour dairy labor requirement seemed to be more appropriate for 1970. The flexibility restraints tested had very little effect on predicted area milk output.

In New York, preliminary tests of an area aggregative model have been completed. The problems encountered in making and using a profit-maximizing linear programming model which considers both individual farm constraints and aggregate constraints have been largely overcome. At the completion of the tests, a series of profit-maximizing models were made. These models may be combined into multiple-farm or multiple-area models. They reflect the differences in rates of transformation, prices of inputs and products, and costs of transfer of inputs or products between farm situations and producing areas. These models will be used to assess the milk supply response, and competitive position of farmers, in 7 areas in the New York-New Jersey milkshed for the years 1964 and 1970. This analysis will concentrate on the supply side, and will develop it fully enough so that supply-demand equilibria and spatial equilibria may be determined without additional supply analysis. If an aggregate market demand function were equated with the aggregate supply functions to be developed in this analysis, the quantity, price, and location of production, and the amount of factors of production needed could be determined without further supply analysis.

In the last 2 years ERS has cooperated in a producer panel of dairy farmers in New York, New Jersey, and Pennsylvania that gathers information on changes in number, size, organization, and production of dairy farms over time. During the summer approximately 2,600 dairy farmers, former dairy farmers, and potential dairy farmers were interviewed to determine the organization of their businesses, the resources used, their product output, and their plans for the immediate future. Because the same respondents have been contacted annually since 1960, these data provide excellent information on changes which are occurring in dairy farming in New York, New Jersey and Pennsylvania. Such information is indispensable in the analysis of firm entry, growth, and exit phenomena, and in milk supply response, dairy farm adjustment, and inter-area competition studies. The producer panel data will be used to determine the typical farm area resource situations for analysis in New York dairy adjustment and supply response studies.

In Wisconsin, 2 projects are underway on the economics of forage handling systems and the operation and costs of liquid manure systems. During the year 44 operators with liquid manure systems were surveyed, but no results are available at this time. In the forage handling systems project, it was determined that differences in costs of handling baled hay, chopped hay and haylage were relatively minor when quality differences were taken into

account. The more mechanized haylage systems were found to be least costly on the larger operations which hired high-priced labor. Conversely, on the smaller operations with an abundance of family labor, the lesser mechanized baling systems proved more efficient.

D. Appraisal of Adjustments in Cotton, Tobacco, and Peanut Areas

Aggregate supply response to 12 cotton allotment and price situations were completed for 14 cotton-producing areas in the South. The aggregates were estimated from optimum organizations of representative farms in each of the areas. A beltwide report of the estimates of aggregate supply and farm returns was completed. Aggregate returns from the 14 cotton-producing areas were influenced more by the price of cotton than by the level of cotton allotment. For example, an increase of 20 percent in the price of cotton (25 to 30 cents per pound) with 85 percent of the 1963 allotment would increase returns to overhead, land, and operator's labor and management \$219.1 million compared to an increase of only \$27.4 million when the allotments were increased from 85 percent to 100 percent at the 25-cent price. In addition, optimum organizations for minimum land required for \$5,000 in returns to operators were developed for each area for each of the 12 cotton allotment and price situations.

In the burley-tobacco-producing areas of Kentucky, North Carolina, Tennessee, and Virginia, optimum organizations and aggregate acreage, production, and incomes were computed for 12 tobacco-price and allotment situations. Area aggregates for the burley tobacco areas are being compiled for regional aggregates of land use, production, and income. In Virginia, the analysis showed the optimum organizations to include the full burley tobacco allotments at tobacco prices of 0.252 cents per pound or higher when labor was available at \$1.00 per hour.

Studies have continued in the flue-cured tobacco areas of North Carolina, South Carolina, Georgia, and Virginia. Refinements in production coefficients are being made for the enterprise budgets used to program the variable tobacco price and allotments. Aggregate estimates will be made of optimum adjustments for 12 tobacco allotment and price situations.

Studies are underway in the cotton-producing areas where peanuts are of major commercial importance to determine optimum adjustments of representative farms for 12 peanut allotment and price situations, and to compile area and regional estimates of optimum adjustments in land use, production and income. The peanut investigations are being made in 3 areas in Georgia, 1 area in Alabama, 1 area in Oklahoma, and 2 areas in Texas. Optimum organizations of representative farms for 12 peanut allotment and price situations have been completed. Aggregations of acreages, production, and income have been completed in some of the areas. In one area in Texas, peanuts were profitable at prices as low as 8 cents per pound when other prices were at base levels corresponding to 25 cents

per pound for cotton. In this area, when peanuts were 11 cents per pound, 535 acres would be required to produce a \$5,000 operator's labor and management income.

Additional analysis was carried out in several areas in the South to update production coefficients. Shifts to larger equipment, increased use of chemicals, and improved varieties are responsible for the changes. Reevaluation of yields related to different classes of land and production practices have also been made in some areas.

Studies in the San Joaquin and Imperial Valleys of California that are comparable to those in the South are progressing under the same methods of analysis. All computation work has been completed and compiled into manuscript tables. Two reports are being developed.

E. Appraisal of Adjustments in Wheat Areas

Work progressed on studies of adjustments in wheat areas in the Great Plains and the Pacific Northwest. The studies are in cooperation with Regional Research Projects W-54 and GP-5, which are, respectively, cooperative adjustment projects in the West and Great Plains. Work proceeded on delineation of adjustment study areas, selection of representative farms, development of enterprise input-output coefficients, estimation of optimum systems of farming for the representative farms by linear programming procedures, and area and regional aggregation of production response, resource requirements and farm income.

In Nebraska, medium-sized representative crop farms were programmed for each of 6 areas. Generally, under a wide range of wheat prices, the wheat-fallow system was found most profitable in western Nebraska. In the central and east central areas, a combination of wheat, feed grains, and fallow was generally most profitable. The cow-calf enterprise was the dominant livestock enterprise. Wheat enterprise cost data were secured in 3 areas of the Nebraska Panhandle. Most of the analysis of cost of producing wheat and economies of size on wheat farms has been completed for use in a Master's thesis.

In Kansas, linear programming results were computed using parametric prices for wheat at 5 feed grain price levels for 10 representative farms in 4 adjustment areas. Aggregations of acreage and production of wheat, feed grains, soybeans, hay and forage, silage, and pasture; numbers of livestock produced; hours of labor (hired and operator) used; capital; and returns to operator, land, and overhead, were completed and submitted to the GP-5 Regional Subcommittee. Wheat and grain sorghum are the most profitable crops in all areas. Barley and oats did not enter any solution under the price assumptions used. Stocker cattle were more profitable than beef cowherds. Additional programming has been done to analyze the effect of type of farm on supply response and income. Work has started on preparation of a manuscript reporting results in one area. A Master's thesis,

"A Study of Irrigated Farm Organization Adjustments in Southwestern Kansas," has been completed.

In Colorado, data were prepared and linear programming solutions obtained for each of the 5 eastern Colorado areas using a medium cattle price, 5 feed grain price levels, and wheat prices from zero to \$5.00 per bushel. Most of the changes in farm organization occurred when wheat was priced between \$0.70 and \$1.50 per bushel. Totals for each of the areas were sent to the Regional Aggregation Subcommittee of GP-5.

In North Dakota, work accomplished in direct connection with the GP-5 study includes programming and aggregation of results for 5 adjustment areas, preparation of review drafts for crop enterprise costs and returns based on GP-5 coefficients planned for publication as North Dakota Extension Service circulars, and a wheat supply response study in northwestern North Dakota using alternative Government program (and price) assumptions within a minimum resource framework for specific income goals. The importance of wheat allotments to northwestern North Dakota farmers is indicated by the fact that land requirements to obtain specified incomes are about one-third less under 1967 Government program assumptions than they were under the 1966 program, using identical wheat prices and land equities. The smaller acreage required with 1967 program assumptions was due solely to the 32-percent increase in wheat allotments per unit of cropland.

In South Dakota, optimal solutions for 14 representative wheat farms have been obtained using a parametric price program for wheat at 5 specified feed grain price levels. In some areas 2 sets of solutions were obtained, one set allowing cattle and hog fattening and another set allowing wintering and grazing livestock activities but excluding fattening. The programming results, excluding livestock fattening, have been aggregated and submitted to the GP-5 Regional Aggregation Subcommittee. Machinery cost data tables by tillage, planting, and harvesting operations for selected crops have been completed and a draft of a proposed machinery cost data publication has been begun.

In Montana, using updated enterprise budgets, linear programming, and budgeting procedures, solutions were obtained for 15 representative farms, 4 sizes of cash grain farms, and 1 crop-livestock farm by variable wheat and feed grain prices in each of 3 adjustment areas. Aggregations have been completed but no analysis of the data has been undertaken.

In a study of adjustments on farms in wheat-producing areas of Oklahoma, representative farms in 3 areas of the State were programmed and the results were aggregated for use in the GP-5 regional project. The aggregated results showed the relation between total amount of wheat that it would be profitable to produce and the price of wheat and other competing enterprises.

In Texas, aggregate wheat supply response estimates were developed for 3 type-of-farming areas. The effect of alternative price levels for wheat, sorghums and cotton on wheat production was evaluated. With the price of other crops at normal levels, wheat output was maximized at about \$2.00 per bushel; however, at high cotton prices, a wheat price of about \$3.00 was required to bring forth the maximum wheat production. The effect of sorghum prices was not as great.

In Idaho, work was concentrated on the dryland wheat area in the southeastern part of the State. Work was completed on projected production costs and farm budgets for 1,000-, 2,000- and 3,000-acre farms in 1970. Supply functions for wheat and barley were constructed and found to be highly inelastic. A report summarizing this work has been approved for publication. Results of the research have been used to help determine variations in net income of dryland farmers in southeastern Idaho and explain changes in farming with regard to increasing size of farms and the tendency of farmers to cease operation.

In Washington, work continued on the programming phase of Regional Research Project W-54. Each of several regions in the Pacific Northwest were programmed to accomplish the objectives of the regional project. Results of the programming work are being aggregated to form the basis for a bulletin manuscript. Other related research completed during the year included a study of the costs economies of adopting green pea combines in the green pea area of Washington and Oregon, and a study of the adjustment opportunities in the transition zone between the annual cropping and summer fallow regions of eastern Washington in terms of the optimal fertilization rates and land-use patterns under alternative price and governmental program expectations. Results indicate weather variation in the region is one of the major determinants of optimal strategies.

In Oregon, work on the production response study in the wheat-fallow area of the Oregon Columbia Basin was completed. In aggregate, the combined acreage of wheat, barley, and fallow has been nearly invariant over the last 10 years in this 5-county area of the Columbia Basin. Budgets were developed for analysis of expected total acreage of wheat, barley, and fallow and total output under various wheat and barley prices and projected 1970 technology. Results indicate that all subareas would be earning positive (though very low) returns to land, management, family labor, and fixed overhead costs at 58 cents per bushel of wheat. All evidence suggests that unless barley prices exceed wheat prices on a pound-for-pound basis no barley would be produced. Evidence also suggests that wheat prices of \$1.30 per bushel would cover current market opportunity costs for resources used in wheat production in all subareas considered. Under the assumptions of the study, wheat acreage in the study area would be 29 percent greater than was planted in 1964 with no barley planted at all. Some preliminary work on more accurate yield expectation models was closely related to this project. Preliminary regression

equations relating time and weather to yield have explained only 65 to 78 percent of the yield variation.

F. Appraisal of Adjustments in Rice Areas

In a continuation of a study of adjustments in rice areas of the South, the emphasis has been on the effect of 5 allotment levels and 5 rice prices on rice production, farm income and the most profitable enterprise mix. The results of this phase of the study are in the process of being published. In all areas except the Coastal Prairie area of Texas the total acreage permitted under all allotment levels came into the optimum resource use program with rice priced at \$3.60 per 100 pounds, with competing enterprises priced at their estimated long-run equilibrium price. In the Coastal Prairie of Texas only about 86 percent of the acreage of first crop rice permitted at the various allotment levels came into the optimum resource use program with rice priced at \$3.60 per 100 pounds. With allotments at 90 percent of the 1964 allotment level, a price of \$4.80 per 100 pounds was required to bring in the full acreage permitted; at the 100-percent and the 110-percent levels, a price of \$4.40 was adequate to bring in the full allotment; and at the 130- and 150-percent levels only \$4.00 was required. With allotments at the 1964 level the total acreage in the optimum resource use program for all southern producing areas was 1.1 million acres, and production was about 54 million cwt. of rough rice. With allotments at 110 percent of the 1964 base, these acreage and production figures were 1.2 and 59.5 million, respectively; at the 130-percent allotment, they were 1.4 and 69.2 million; and at the 150-percent level, they were 1.6 and 77.2 million. With allotments at the 1964 base, and a price of \$4.80 per 100 pounds for rice, the total income to rice farmers in the Southern areas for use of land, management services, and general farm overhead would total about \$253 million. Increasing rice allotments to 110 percent of the base and holding the price received constant would raise incomes to \$264 million, and increasing acreages to 130 percent would raise incomes to \$283 million. Increasing the price received from \$4.80 to \$5.20 per 100 pounds with allotments at the base level, resulted in incomes shifting upward from \$253 million to \$274 million; with allotments at 110 percent of base, a shift upward from \$264 million and \$280 million; and with allotments at 130 percent of base, a shift upward from \$283 million to \$311 million.

During 1967 additional data were compiled indicating the extent of tenancy among rice farmers and the usual division of income and costs per acre of rice. A high proportion of the rice acreage is farmed either by straight renters or by part-owners who rent a large proportion of the total acres farmed. The proportion of the total rice acreage grown on rented land is smallest in the Mississippi River Delta (about one-third); is comparatively high for northeast Arkansas, southwest Louisiana, and the Coastal Prairie of Texas (a little under two-thirds); and is surprisingly high in the Grand Prairie of Arkansas (about three-fourths). Prevailing rental agreements vary between areas, both in terms of the division of the crop, and

in the average per unit costs for the shares received by each party. For example, in the Grand Prairie area of Arkansas, after all variable costs and a nominal fixed cost for management are accounted for, the 50-50 crop share arrangements give an average cost of \$3.56 per 100 pounds to the renter-operator and \$3.50 to the landowner who supplies irrigation water and half of the seed, fertilizer, chemicals, plane service, and drying costs. However, a similar arrangement used in the Delta area results in average costs to the renter-operator of approximately \$5.00 per 100 pounds, and of \$4.35 to the landowner. Cost relationships that are out of balance, as in the Delta, can have an important influence on the supply function for such areas, especially when account is taken of the fact that costs to the renter-operator are largely for variable items, such as labor, fertilizer, chemicals, and custom services which often are more subject to change between seasons than are interest rates, depreciation, and land charges. Only a slight change in price received would have a marked influence on annual income for renter-operators.

Research to determine the effects of allotment-price variations on farm program costs was continued in Texas. Results indicate that the price elasticity of demand for domestic use is quite low, $-.27$ in 1963. The income elasticity of demand for the same year was about 2.5 times that of the price elasticity. The estimated elasticity of demand for exports is about 6 times the elasticity of domestic demand. A 10-percent variation in price or allotment level has little effect on domestic use. However, any change in allotment level is reflected by a corresponding change in exports. Variations in price affected Treasury cost more than similar variations in allotment levels. A paper on this work was entered in the FAO's "International Rice Research Competition" and submitted to the editors of "Agricultural Economics Research."

Information was obtained for a second year from farmers in the Grand Prairie area of Arkansas pertaining to the influence of weather conditions on production plans and the restrictions which weather imposes on such plans. Farmers reported losses in field time for varying amounts and frequency of rain. This information has been combined with historical rainfall data for the area to determine probability levels for given amounts of available field time during critical periods of cultural operations for which delays normally result in yield reductions. Yield and income reductions associated with untimely planting of rice and soybeans have been estimated. Three sets of labor and equipment combinations and associated coefficients of equipment performance were synthesized and their effect on income studied in light of appropriate planting dates.

In California, budgets have been prepared for 5 farm sizes in 6 different soil-water cost areas of the Sacramento Valley. Linear programming matrices have been developed to determine optimum cropping programs for these 30 farms. A graduate student has completed a dissertation using a transportation model for world production and trade flows for rice.

G. Appraisal of Adjustments in Feed-Livestock Areas

Research on the cooperative regional study of adjustments in hog and beef cattle production (Regional Research Project NC-54) is completed except for publication of results. Two reports -- "Beef, Pork, and Feed Grains in the Corn Belt: Supply Response and Resource Adjustments" and "Evaluation of a Firm Model in Estimating Supply Response" -- will be published in the North Central Regional Series. The study in Iowa, for example, showed that capital, labor, and land are available to Iowa farmers in quantities sufficient to enable them to greatly expand the production of hogs, beef cattle, corn and soybeans. In the analytical model used in which all farmers were assumed to use advanced technology and achieve optimum returns, the production of corn and soybeans was found to be a function of both the corn-soybean price ratio and the beef-hog price ratio. When hog prices were high relative to beef cattle prices, corn production became relatively more profitable than soybean production. Soybean production could have been profitably increased to about 9 million acres if the price of soybeans were \$3.00 a bushel, the price of corn \$1.00 a bushel, and the price of hogs was low relative to the price of beef cattle. Under the optimal conditions assumed in the model, production costs were reduced. But with the low elasticity of demand for hogs and beef, aggregate farm income would be lower if all farmers met the conditions specified in the model. The optimal production of hogs would be affected more than that of beef cattle by a decline in the labor supply on farms.

An economic analysis of production problems and adjustments on Western livestock ranches continued under Regional Research Project W-79. The general objective of this study is to examine the effect of various adjustments in livestock inventories and livestock management practices on costs and returns of typical livestock ranching organizations. An additional objective is an analysis of ranch adjustment through time to current and projected changes in the economic, institutional, and physical environment in which the ranch firm operates. Also, a further objective is to estimate the production response of the range livestock industry to economic stimuli. Work during the past year has concentrated on an analysis of the current structure and financial situation on representative ranches. The Division is cooperating in the work in California, Oregon, Texas, Colorado, and Montana. This phase of the regional study is approaching completion except in Montana where lack of personnel until about midyear delayed progress of the work. The scope and method of analysis of the current situation was discussed in the report of progress last year.

In California, 63 representative livestock ranch budgets (46 cattle; 17 sheep) were constructed depicting typical sizes of range operations in 8 major California ranching areas. These budgets were constructed from information received in more than 300 personal interviews with California ranchers. The economic, physical, and management characteristics of each representative ranch are presented in an 18-page budget format. After the budgets were completed, discussions were held with farm advisors and

ranchers to verify the results of the budgets in each area. This procedure resulted in minor changes in some of the ranch budgets. The more important characteristics of each budget were summarized by type of operation and ranching area. Data from the budgets and area summaries are currently being prepared for publication in a series of 8 reports which will describe the major economic and operating characteristics of livestock ranches in each ranching area. One of these reports, "Economic and Operating Characteristics of the Sacramento Valley Range Livestock Industry," is in the initial stages of publication review.

In Texas, a report on the economic and operational characteristics of 21 representative cattle ranches in the High Plains and Rolling Plains is in process of publication. Highest returns to capital and management per acre were obtained on ranches that were largest in total acres, had more than one enterprise, had the highest percentage calf crop, had the lowest death losses, and used the cow-calf yearling cattle system. Work is underway on the construction of budgets for 27 representative ranch situations in the Edwards Plateau and Central Basin. Returns above cash expenses per acre from deer hunting as a supplementary enterprise in the Central Basin in 1964 were \$.82 for a season lease, \$1.47 for lease by the day, and \$.88 for a combination season and day lease arrangement. The season lease yielded the lowest return per acre and was less flexible in controlling kill rates but it required less of the operator's time and generally the same hunters returned to hunt year after year.

In Colorado, 6 representative ranches in the Rocky Mountain area and 5 in the Central High Plains area have been analyzed in accordance with the format outlined by the W-79 Regional Committee.

In Montana, the collection of data from ranchers for analysis is progressing through a survey of ranch-livestock operations in the Northern Great Plains and the Northwest Mountain area.

An economic analysis of production problems and adjustments on range-livestock ranches in the Northwest Mountain and High Desert Plateau areas has centered on an evaluation of the optimum livestock inventory structure for the High Desert Plateau area of eastern Oregon. Results of the analysis indicate that public land policy in the area influences ranch organization and management. Scientists at the Squaw Butte Range Experiment Station, which is located in the study area, have reported that their experiments indicate that ranchers should produce more yearling and older beef animals. The results of the economic model developed indicate the same result if one assumes the land base to be in complete control of the rancher. However, the ranchers tend toward production of beef calves, with which the results of the economic model also agree. Under conditions of public land "dependency," ranchers should produce as they are doing and not as the Experiment Station results indicate. This condition does not result from the fee level but rather from the fee structure for the various types and ages of livestock. Although the reason was intuitively clear

before the study, the results quantify, clearly isolate, and explain the reason for the discrepancy between "what is" and "what ought to be." The use of Bayesian statistics for decision-making under uncertainty were investigated in a model for a multivariate case with respect to uncertainty of price in the next period. However, an algorithm for establishing the Bayesian strategy from a very large admissible strategy set remains to be developed. Until a means other than iteration is found, these results are not sufficiently operational for applied research. The above results will be published in the coming year.

A study of the economics of adjustments in beef production in selected regions is directed to an assessment of the potential and competitive aspects of fed beef production in the Southwest (Arizona), Pacific Northwest (Oregon), South Platte Valley (Colorado), and Corn Belt (Illinois and Nebraska). The primary questions being researched concern the present and projected cost structures of firms operating in the several regions and the relative competitive position of commercial feedlots and small-scale beef feeding on multienterprise farms. A report, "Cattle Feeding Costs in Nebraska by System of Feeding and Size of Operation," is in process of publication. Two reports on the cost of producing irrigated crops in the South Platte Valley of Colorado were published. A Master's thesis is in process on the competitive position of the beef enterprise on west central Illinois farms. Two graduate students are developing Master's theses on feed conversion rates and feed costs in Arizona as related to composition of rations, characteristics of animals, and other factors as recorded for 120 lots of cattle fed in Arizona feedlots and for a considerable number of cattle feeding experiments conducted by the Arizona Experiment Station. In Oregon, a report is in process on the current situation of the Pacific Northwest beef industry, and plans have been developed for a survey of Pacific Northwest feedlots to obtain data on growth patterns and cost structure. Preliminary findings indicate that the Pacific Northwest produces enough beef to be self-sufficient. However, seasonality of supply and demand for fed beef, and shipment records, indicate interregional imports and exports of beef to and from the Pacific Northwest. Yet to be determined is whether, under the existing resource base, adjustments in the Pacific Northwest feeding sector could be made so that seasonal supply would match seasonal demand for fed beef. Preliminary study results also indicate that the major meat packing facilities in the Pacific Northwest are located in the population centers, and not near the supply areas of fed beef. There has been a rapid increase in beef cow numbers in the western portions of Oregon and Washington, areas where historically there has been a deficit of dry roughages. Conclusions are yet to be drawn on the resource mix being used and cost of production in these areas.

H. Appraisal of Agricultural Policies and Programs

A brief study was made of the Cropland Conversion Program in Alabama and Mississippi to appraise the factors associated with participation in the program. The study included 6 of 7 counties in these 2 States in which

the program was offered in 1966. Less than 5 percent of the farmers were in the program in the county with the highest participation. However, participation likely would have been higher if farmers had been offered an opportunity to make the decision earlier in the season. In 5 of the 6 counties studied, poultry production was the major enterprise, with dairying the most important in the sixth county. More than two-thirds of the sales of farm products were from livestock and livestock products in 1964. Farms in the program had significantly larger acreages; they had more cropland, larger feed grain bases and more cattle compared with other farms in their respective counties. However, there was little difference in the acreage of cotton allotment per farm or in crop yields.

About 92 percent of the cotton allotments and 59 percent of the feed grain base acreage were diverted to pasture. Cotton and feed grains, however, accounted for a much smaller proportion of the cropland on participating farms than on neighboring farms. Consequently, the loss of these allotments and bases had little effect on the organization of the farms.

Studies were made in Louisiana and Mississippi to evaluate farmers' choices under the 1967 Cotton Program. Both studies assumed that participation in the program would be more profitable than nonparticipation. The analysis was limited to selection of the most profitable percentage of allotment to divert and the combination of skip-row and solid planting, with various combinations of land available for crops, cotton yields and land quality, tenure, mechanical versus hand harvest, and returns from alternative crops. Results of the studies were published prior to the 1967 planting season. The primary purpose of the studies was to provide guides for farmers in planning their 1967 cotton production program.

In a study in Illinois, an attempt was made to use secondary data in finding factors associated with participation in farm programs. Analysis was made of the rates of participation in the Feed Grain Programs by counties in Illinois from 1961 to 1966. Analysis to date reveals only a few factors correlated with participation; for some of these factors a rational hypothesis is lacking. For example, participation was positively associated with average corn yield in the previous year. A second stage of the analysis included 13 factors which varied among counties but which were relatively constant through the time of analysis. Participation in the Feed Grain Programs was found to be positively correlated with the proportion of cash grain farms in a county, the proportion of the cropland harvested as corn for grain, and the percentage of cropland not harvested in 1959. Variance in corn yield from year to year was negatively associated with participation. No significant relation was found between the percentage of farms participating in the Feed Grain Programs and the incidence of part-time or part-retirement farming, tenure status, educational level, place of residence of the operator, or other sociological factors.

A study was made in North Carolina to develop a method for estimating the acreage of corn that would have been planted in the absence of the Feed Grain Programs in 1961 to 1965 and to explain participation in the Feed Grain Programs in 2 areas of North Carolina. A distributed lag model and a cobweb type model were tested in each area. In the area where tobacco was the major crop, the distributed lag model best explained the variations in the acreage used for corn, whereas in the area where corn was the major crop, the cobweb, or full adjustment model provided the best explanation. In the tobacco area the deflated prices of corn and soybeans were the chief explanatory variables. In the predominantly corn area, the yield of corn and acreage allotment crops were the most important variables influencing the acreage of corn. Changes in program provisions were an important factor in changes in participation in the Feed Grain Programs, but off-farm work, the price of corn, normal yield of corn, and soybean yields also explained part of the changes.

A study underway in Oklahoma is designed to determine the theoretical efficiency of alternative Government programs to restrict production, and to analyze the factors that determine program participation and farmers' response to alternatives. About 250 farmers will be interviewed beginning in September 1967, to test their reactions to untried as well as past farm programs.

A study is being developed to estimate the productivity of some 40 million acres diverted under Government programs. A wide range of estimates is now being used to appraise potential production from diverted acreage. A nationwide survey of farms is planned. Data collection is scheduled for January 1968, and preliminary results are expected to be available by Spring of 1968.

I. Cotton Cost Analysis

The results of a belt-wide enumerative survey of cotton production practices and costs on about 4,700 farms are reported in the 1965 Supplement to "Costs of Producing Upland Cotton in the United States, 1964." Data are presented for each of 15 major cotton production regions.

The total cost of producing the U. S. crop of upland cotton in 1965 was 27.3 cents per pound of lint, compared with 28.4 cents per pound in 1964. About 73 percent of U. S. cotton was produced at a total cost of less than 30 cents per pound in 1965, compared with 64 percent in 1964. These costs include market rates of return to all inputs used except unpaid management. The one-cent decline in cost per pound in 1965 was due chiefly to higher yields. A decline in labor inputs, especially hand harvesting, also contributed to the lower cost. Labor costs per acre harvested in 1964 totaled \$42 and dropped to \$37 per acre in 1965. Per acre costs of most other inputs increased from 1964. Power and equipment costs per acre harvested increased from \$34 in 1964 to \$37 in 1965.

About 85 percent of the 1965 crop was machine harvested as compared with 76 percent of the 1964 crop.

Estimates of total cost per pound of lint in 1965 ranged from 24.7 cents in the Mississippi Delta region to 34.9 cents in the Upper Rio Grande-Trans-Pecos region of Texas and New Mexico. Total costs per pound of lint in 5 regions averaged less than 26 cents. These regions were the Mississippi Delta, Southern California and Southwest Arizona, the Coastal Prairie of Texas, the High Plains of Texas, and the Rolling Plains of Texas-Oklahoma. Total costs in these 5 regions ranged narrowly from 24.7 cents to 25.3 cents per pound of lint in 1965. The first 3 regions listed above were among the 4 lowest-cost regions in 1964.

Cooperative research has made progress in several Southern areas in evaluating the effects of alternative practices on costs of producing cotton. In Georgia, records from 128 farms in 1965 and 110 of the same farms in 1966 were analyzed. Each farm selected for study was following some innovation in cotton-production methods. The average costs per pound of lint, as determined by a budgetary analysis using least cost methods and solid planting, were 19.9 and 19.3 cents in the Southeastern and Southwestern Coastal Plains, respectively. Preliminary results indicate that through proper selection of practices, production costs can be reduced from 5 to 8 cents per pound for much of the cotton grown in Georgia.

In the South Carolina Upper Coastal Plain, production information and costs were collected from about 65 cotton producers for the 1965 and 1966 crop years. Records from these farms show production costs ranged from a high of 31.4 cents to a low of 16.1 cents per pound. The analysis further shows a high correlation between yield per acre and costs per pound. For example, on farms where the costs per pound were less than 18 cents, yields of lint averaged 1,022 pounds; where the costs were 18 to 21.9 cents, yields averaged 827 pounds; and where costs were 22 cents or more per pound, yields were 757 pounds. Approximately 90 budgets for cotton production and cotton alternatives have been developed to represent various levels of technological innovations including solid and skip-row planting patterns for cotton.

Innovating cotton farmers in Tennessee were selected from 4 areas and their farm records analyzed. The average costs per pound of lint on these farms in 1965 was 15.51 cents. Costs per pound in the Brown Soil area averaged 15.16 cents and in the Hill area of West Tennessee 18.86 cents. Records of production costs under controlled experiments were obtained from the University of Tennessee's Ames Plantation where the lowest cost combination of practices resulted in a cost of only 10.19 cents per pound in 1966. Budgets are being developed for various combinations of production practices in each of the 4 study areas.

In the Mississippi Delta, 46 farmers are providing detailed information on cotton production practices and costs and additional information has

been obtained from a survey of 96 cotton producers selected at random.

Analysis of the data has been made comparing farms using 4-row and 6-row equipment. As a part of the study, estimates are being made of the effect of rainfall on number of days suitable for field work.

Cooperative experiments with chemical weed control are being conducted on 84 acres of cotton planted in a 4 x 4 pattern on the Delta Branch Experiment Station. Total weed control costs for each test are being determined.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. National and Regional Productivity in Agriculture

Farm Production Economics Division. 1967. Changes in farm production and efficiency. Stat. Bul. 233 (revised). 17 pp.

Farm Production Economics Division. 1967. Changes in farm production and efficiency. Index numbers of farm production, by groups of live-stock and crops, for each farm production region, 1939-66. Stat. Bul. 233 (revised). Sup. 1. 12 pp.

B. Appraisal of Production Response and Needs for Adjustment

Lee, John E., Jr. 1967. Improving aggregation validity. Proceedings, Conference on Implications of Structural and Market Changes on Farm Management and Marketing Research, Iowa State Univ., pp. 340-357.

Stovall, John G. 1966. Income variations and selection of enterprises. Jour. Farm Econ. 48(5), pp. 1575-1579.

C. Appraisal of Adjustments in Dairy Areas

Frick, G. E. and Christensen, R. L. 1967. Base-incentive cow rental contract. Univ. of N. H. Ext. Cir. 388. 12 pp.

Harrington, D. H. and Christensen, R. L. 1967. Using computer programming to increase profits on a dairy farm. Univ. of N. H. Ext. Bul. 164. 47 pp.

Zepp, G. A. and McAlexander, R. H. 1967. Farm adjustments in southeastern Pennsylvania, 1960-1965. Pa. Agr. Expt. Sta. Prog. Rpt. 274. 7 pp.

D. Appraisal of Adjustments in Cotton, Tobacco, and Peanut Areas

Butler, Charles P. 1967. An economic appraisal of cotton allotment transfer in South Carolina. S. C. Agr. Expt. Sta. AE 298. 16 pp.

Givan, William D. 1966. How much is an acre of burley tobacco worth? Va. Polytechnic Inst. Va. Farm Econ. 200, pp. 3-8.

Hatch, R. E. and Moore, D. S. 1967. Aggregate farm production and returns under alternative cotton prices and allotments in the Rolling Plains of Texas. Tex. Agr. Expt. Sta. MP-831. 60 pp.

Hatch, R. E., Moore, D. S., and Rogers, R. H. 1966. Aggregate farm production and returns under alternative cotton prices and allotments -- Gulf Coast Prairie of Texas. Tex. Agr. Expt. Sta. MP-818. 48 pp.

Hubbard, John W. and Burch, Thomas A. 1967. Aggregate farm production and income effects of changes in cotton allotments and prices in South Carolina. S. C. Agr. Expt. Sta. Bul. 533. 50 pp.

Kletke, Darrel D. and Tweeten, L. G. 1966. Enterprise budgets and farm plans for sandy soils of southwest Oklahoma. Okla. Agr. Expt. Sta. Processed Ser. P-553. 56 pp.

McArthur, W. C., Brodnax, Henry D., Jr., and Saunders, Fred B. 1966. Minimum land requirements for specified incomes for general crop-livestock farms, southwest coastal plain area, Georgia. Ga. Agr. Expt. Sta. Bul. N. S. 178. 28 pp.

Olson, C. E. and Walker, O. L. 1966. Agricultural adjustments and area economic interrelationships. Jour. of Farm Econ. 48(5), pp. 1570-1574.

Farm Production Economics Division and Members of S-42 Technical Committee. 1966. Cotton: supply, demand, and farm resource use. Southern Cooperative Ser. Bul. 110. 140 pp. (Published by Ark. Agr. Expt. Sta.)

E. Appraisal of Adjustments in Wheat Areas

Brengle, K. G. and Sitler, H. G. 1966. A procedure for projecting yields for linear programming of dryland wheat farms in eastern Colorado. Agronomy Jour. Vol. 58, pp. 637-638.

Connor, Larry J., Hall, H. D., Walker, O. D., and Tomlinson, Jim. 1966. Alternative crop enterprises on clay and loam soils of north central Oklahoma -- resource requirements, costs and returns. Okla. Agr. Expt. Sta. Processed Ser. P-550. 29 pp.

Connor, Larry J., Hatch, Roy E., and Walker, O. D. 1966. Alternate crop enterprises on loam and sandy soils of northwest Oklahoma -- resource requirements, costs and returns. Okla. Agr. Expt. Sta. Processed Ser. P-552. 28 pp.

Duff, Jack Barton and Whittlesey, N. K. 1966. The economic effects of technological change on the northwest green pea industry. Proceedings of Western Farm Economics Association. 10 pp.

Duff, Jack Barton and Whittlesey, N. K. 1966. Harvesting costs for the self-propelled green pea combine -- eastern Washington and eastern Oregon. Wash. State Univ. Cir. 468. 18 pp.

Rude, L. C. 1966. Projection of farm numbers in Montana to 1975 and 2000. Mont. Agr. Expt. Sta. Bul. 608. 13 pp.

Whittlesey, N. K. 1966. The price of wheat: its impact on different farm types and sizes. Wash. State Univ., E. M. 2689. 11 pp.

Whittlesey, N. K. 1966. Farm organization and farm profits: adjustments to changing wheat and livestock prices. Wash. State Univ., E. M. 2690.

Whittlesey, N. K., Noteboom, I. A., and Butcher, W. R. 1966. Effect of product price relationships on farm organization and income in the Palouse region of Washington and Idaho. Wash. Agr. Expt. Sta. Bul. 674. 24 pp.

F. Appraisals of Adjustments in Rice Areas

Grant, W. R. and Mullins, Troy. 1967. Effects of allotment and price changes on rice farms in the Mississippi River Delta. Ark. Agr. Expt. Sta. Rpt. Ser. 156. 32 pp.

Hottel, J. B. 1967. Capital investments and performance capacities of different tractor and machinery sets under varying risk situation due to weather, Grand Prairie rice area, Arkansas. The Rice Jour., Annual Issue. 5 pp.

Mullins, Troy, Grant, W. R., Campbell, J. R., Gerlow, A. R., Bonnen, C. A., and Welsch, D. E. 1967. Resource use adjustments to price changes in southern rice areas, Part 1: effects of price changes with unrestricted rice acreages. Southern Cooperative Ser. Bul. 122. 62 pp. (Published by Ark. Agr. Expt. Sta.)

G. Appraisal of Adjustments in Feed-Livestock Areas

Boykin, Calvin C. 1966. Profitability and flexibility of two range cattle systems in the Rolling Plains of Texas. Summary of Proceedings, 15th Annual Texas Farm and Ranch School for Commercial Bankers, Tex. A & M Univ., pp. 1-5.

Boykin, Calvin C. 1967. Costs and returns from commercial breeding operations. 1967 Proceedings 17th Beef Shortcourse, Tex. A & M Univ., pp. 1-15.

Boykin, Calvin C. 1967. Maximizing profits under conditions of variable output. 1967 Proceedings Great Plains Agricultural Council, pp. 1-15.

Heagler, Arthur M. and Bolton, Bill. 1967. Cost of producing beef gains with a high-energy corn silage feeding system, Mississippi River Delta area. La. Agr. Expt. Sta. D.A.E. Res. Rpt. 365. 24 pp.

Hunter, Elmer C. 1966. Costs of selected sizes and types of farm machinery on irrigated farms, South Platte Valley, Colorado. Colo. State Univ., Cooperative Extension Service. Unnumbered publication. 8 pp.

Hunter, Elmer C. 1967. Crop enterprise costs on irrigated lands for South Platte Valley, Colorado. Colo. State Univ., Cooperative Extension Service. Unnumbered publication. 15 pp.

Johnson, Ralph D. and Eckert, Alfred R. 1967. Cattle feeding costs by system of feeding and size of operation. Univ. of Nebr., College of Agr. and Home Econ. Quarterly, pp. 10-11.

Stovall, John G. 1967. The structure of the beef industry in the South. Proceedings of the Association of Southern Agricultural Workers. 15 pp.

Van Arsdall, R. N. 1967. Costs and returns of cattle feeding. 1967 Proceedings American Society of Animal Science. 15 pp.

H. Appraisal of Agricultural Policies and Programs

Bolton, Bill, Heagler, Arthur M., and St. Clargy, Clyde. 1967. Choices under the 1967 cotton program. La. Ext. Serv. and La. State Univ., Dept. Agr. Econ. and Agribus. Unnumbered. 23 pp.

Robinson, Bobby H. and Hoover, Dale M. 1967. An economic analysis of factors affecting the acreage of corn in North Carolina. N. C. Agr. Expt. Sta. Tech. Bul. 182. 76 pp.

Tompkin, J. Robert, Rafeld, F. J., and Kimmet, D. E. 1967. Farmers' responses to the feed grain program in the Ohio corn belt area. Ohio Agr. Expt. Sta. Res. Bul. 991. 16 pp.

Tramel, Thomas E. and Cooke, Fred T., Jr. 1967. An evaluation of alternatives under the cotton program for 1967. Miss. Agr. Expt. Sta. AE MR No. 52. 98 pp.

Vermeer, James. 1967. The 1964-65 cropland conversion program -- a description and appraisal. Agr. Econ. Rpt. 111. 39 pp.

Vermeer, James and Weisgerber, Pius. 1967. Factors related to CCP participation in Alabama and Mississippi. Econ. Res. Serv. Unnumbered. 11 pp.

I. Cotton Cost Analysis

Starbird, I. R. and French, B. L. 1967. Costs of producing upland cotton in the United States, 1964. 1965 Supplement to Agr. Econ. Rpt. 99. 34 pp.

AREA NO. 2. ECONOMICS OF FARM MANAGEMENT AND CONSERVATION PRACTICES

Problem. There are marked differences among the major agricultural areas in the physical and economic environment which determine the possibilities and limitations on successful operation of farms. More information is needed for each type-of-farming region on the patterns of production resources and systems of farming used by individual farmers; the production requirements and output obtained from various enterprises with different methods of operation, including especially those practices that aid in soil and water conservation; the relationships between size of operations, combination of enterprises, production practices used, efficiency in production, and farm financial returns; and alternative opportunities for desirable adjustments, particularly those which conserve soil and water, on farms of different sizes, types, and physical conditions.

USDA AND COOPERATIVE PROGRAM

A continuing long-term program of research dealing with the economics of farm management practices is conducted in cooperation with 6 State Experiment Stations. In the Lake States and Northeast, emphasis is on input-output relationships for dairy and forage. In the Corn Belt, research emphasizes practices in the production of feed grains and hogs. In the South, emphasis is on mechanization and other emerging technologies in cotton and rice production. In the West, a special study was made of the potentialities of sugarbeet production. Studies of the economics of conservation practices are emphasized in Missouri and Texas. While major attention is given to determining input-output relationships, emphasis is also given to economic analyses within the framework of profitability of the practices to the farm as a whole.

A total of 3.1 Federal scientific man-years was devoted to this area of research -- 1.5 man-years in economics of farm management practices and 1.6 in economics of conservation practices.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 48.0 scientist man-years is devoted to this area of research.

PROGRESS -- USDA AND COOPERATIVE PROGRAM

A. Economics of Farm Management Practices

The 1965 records of 160 farmers in southwestern, and 170 farmers in southeastern, Minnesota were summarized and reports of major results published. A special analysis was made of the farms on which a cattle fattening enterprise was conducted to determine the relative importance of feeding

efficiency and price spread on net returns. Three systems of cattle feeding were studied -- long-fed calves, long-fed yearlings and short-fed yearlings. Labor requirements per head and per 100 pounds of gain decreased as the numbers of cattle fed increased. Low feed cost is an important determinant of profit, especially with calves and lightweight cattle. Price spread is relatively more important for cattle that are purchased at heavier weights. Allowing a wage of \$5,000 for the operator's labor, the rate earned on capital "managed" in 1965 was 9.7 percent in southwestern Minnesota and 8.9 percent in southeastern Minnesota, respectively. These rates compare with 4.7 percent and 3.1 percent in 1962 when feeding conditions and prices were less favorable. Results from this project are used extensively as a basis for input-output data in other studies of farm organization and management. The results are also used extensively by farm management extension specialists, teachers of vocational agriculture, lending agencies, and farm advisors.

Selected characteristics of representative irrigated and dryland farms and ranches in the Belle Fourche area of South Dakota have been reported in a manuscript which is being reviewed for publication. Data are presented for size, tenure, land use, number of livestock, debt, and income and expenditures for 5 representative irrigated farms and ranches in the Belle Fourche Irrigation Project and 5 dryland farms in the surrounding dryland area. Budgets of alternative improved systems of farming for each of the typical farms indicate that the most successful approach to increased income is through an increase in size on dryland ranches and through an increase in livestock production on irrigated farms.

Dryland ranches need to include from 5,000 to 9,500 acres to be an economic unit. Most irrigated farms need additional rangeland for pasture for livestock.

Cooperation with the U. S. Irrigation and Dryland Field Station at Newell, South Dakota, was continued in 3 areas: Range fertilization, irrigated pastures, and runoff water storage and conservation. In a comparison of irrigated legume and legume-grass pastures on developed and undeveloped land, steer calves produced greater gains on legume pasture on the undeveloped land, but less labor was used for irrigation on the bench-level developed area. This phase of the research will be terminated at the end of the 1967 pasture season and the experimental results will be published jointly by ERS, ARS and the South Dakota Experiment Station. A report will also be made on the seepage, evaporation, salinity and suitability for human and livestock use, of water stored in unlined, bentonite lined, and rubber membrane lined ponds.

The role of sugarbeet production on Arizona farms was analyzed. The production of sugarbeets was a new enterprise in 1967 on Arizona farms. An analysis of data on the relative costs and returns of alternative crops grown in the Salt River Valley indicate that sugarbeets rank next to cotton in net income over variable costs per acre, but the estimated

returns from sugarbeets were only about a third of the returns from cotton. The returns from sugarbeets, however, were double the returns from grain sorghum or barley. The production costs per acre for sugarbeets was substantially lower in Arizona than in the Imperial Valley of California. A report on the economics of sugarbeet production in central Arizona will be published next year.

B. Economics of Conservation Practices

In an economic appraisal of the use of water for irrigation on southeastern Missouri farms, additional data were assembled from experiments conducted by ARS that involved irrigation of corn on upland soils. It is expected that the additional data will improve the precision and reliability of the yield estimating equation. Nonlinear regression techniques were used to estimate a production function for the yield of corn with rainfall and maximum temperatures for six 10-day periods as the independent variables. A multistage decision model was formulated to derive an optimal intra-seasonal irrigation policy for corn. The model was formulated to allow variable pricing and rationing of the available water supply. Solutions indicating expected return, expected corn yield, and expected water use for 2 selected corn prices and a series of relevant irrigation costs indicate that supplemental irrigation would significantly increase long-run returns over variable costs. A report of the results of implications of the analysis will be completed and published next year.

An assessment of the progressive economic impact and expected life of decreasing water resources in Subdivision No. 1 of the Texas High Plains Underground Water Reservoir involves an analysis of 81 representative resource situations in 4 type-of-farming areas. Linear programming techniques with a 1-year planning horizon are used to determine the period of time over which the return to land, management and operator labor on an irrigated farm exceeds similar returns from the same farm organized and operated as a dryland farm. Since each year's operation uses a specific amount of the remaining resources and has a specific effect both as to the amount of water that can be made available in specified time periods and the unit cost of water, each succeeding year's operation is adjusted to reflect the effect of depletion in the preceding year. This approach permits an appraisal of a dynamic situation wherein the previous use of water is binding on alternative uses in subsequent years. Programming has been underway since last October and, although only one-third of the resource use situations have been programmed in their entirety, it is estimated that about 50 percent of the programming has been completed. A first draft of the first 2 parts of a proposed 3-part report has been prepared. The remaining resource use situations are ready to be programmed. When this phase of the study is completed, an analysis will be made of the apparent alternative opportunities for making adjustments in present systems of irrigated farming in the area.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Economics of Farm Management Practices

Micka, E. S. and Fellows, I. F. 1967. Economic effects of alternative market egg production organizations. Conn. (Storrs) Agr. Expt. Sta. Bul. 403. 20 pp.

Nodland, T. R. 1967. 1966 annual report -- southwestern Minnesota farm management service. Univ. of Minn., Dept. of Agr. Econ. Rpt. No. 289. 24 pp.

Nodland, T. R. 1967. 1966 annual summary -- southeastern Minnesota farm management service. Univ. of Minn., Dept. of Agr. Econ. Rpt. No. 290. 25 pp.

Pherson, C. L. and Nodland, T. R. 1967. Cost and returns from feeding cattle, 1965-66. Univ. of Minn., Dept. of Agr. Econ. Rpt. No. 292. 23 pp.

B. Economics of Conservation Practices

None.

AREA NO. 3. STRUCTURE OF AGRICULTURE AND ECONOMICS OF FARM SIZE

Problem. The rapid changes in American agriculture are generating many pressing problems. Foremost are questions on the character and magnitude of current trends in the structure of agriculture. What is happening to various sizes and kinds of farms? How are working relationships between farmers and other businessmen changing? Equally significant are questions about causes and effects. What incentives, monetary and other, bring about changes in the structure of agriculture? How do these changes affect farm people, rural communities, and nonfarm agricultural businesses? These are fundamentals on which research is needed so that policymakers, farm leaders, farm people, and citizens generally can gain depth of understanding and essential information for action.

USDA AND COOPERATIVE PROGRAM

Novel forms of vertical coordination and reemphasis on old forms have influenced American agriculture in recent years. Basic analysis has been designed to describe existing kinds of vertical coordination and to provide understanding that can lead to improvements. While past attention was centered on coordination of farm production with marketing stages, interest is now directed also to coordination of input resources.

Changes in the number, size, and characteristics of the farm businesses in which American agriculture is organized are continually measured and interpreted. In analyzing these changes, special attention is given to the relative position of various size groups of farms. These relative positions are being developed in terms of total farm marketings, net farm income and farm investment, use of land and hired labor, the age and tenure of operators, and the organization of farm production by commodities and by farm and nonfarm sectors. Increased attention is being given to the geographic and spatial aspects of changes in the degree of concentration of production and to the extent to which changes in the farm supply and marketing sectors may be accelerating or retarding such trends.

The potential efficiency of various size of farms has been determined for each of several types of farms in selected areas. Initially these studies were at the individual firm level, but some have been extended to consideration of the impediments and obstacles these farms will encounter as they strive for more efficient or more profitable sizes and organizations. Several studies are now in the expanded phase of appraising the implications of projected changes in farm size to a type-of-farming area. The Illinois, Minnesota, North Carolina, and Washington Experiment Stations were cooperators in studies of the economics of farm size.

The above program of work, concerned essentially with production structure, is being extended to include the farm supply or input, and the marketing,

structures. Important interrelationships are emerging among the several subsectors of the agribusiness complex that are likely to have increasing implications with respect to the geographic pattern of production and the size and organizational structure of farms.

A total of approximately 9.0 Federal scientific man-years is being devoted to this research area: Vertical coordination and structure, 4.0 man-years; economics of farm size and numbers of farms, 5.0 man-years.

PROGRAM OF STATE EXPERIMENT STATIONS

No scientist man-years reported.

PROGRESS -- USDA AND COOPERATIVE PROGRAM

A. Vertical Coordination and Changing Structure

"Six Farm Input Industries -- Notes on Their Structure" is the title of a report, now in press, that presents a descriptive analysis of 6 selected industries -- petroleum, farm machinery and equipment, fertilizers, pesticides, livestock feeds, and farm credit. The analysis summarizes information about numbers, sizes, and other characteristics of business firms that supply farmers with these significant inputs.

A study of the changing structure, conduct, and performance of the American chemical industry was continued. Professional time was limited by the closely related work of completing the draft manuscript of the "Six Farm Input Industries." One chapter in that report draws on descriptive material from this study. Steps were taken to obtain additional information on the structure of the chemical industry in the current Pesticide Survey.

A revised joint project is being developed with the Marketing Economics Division to examine the changing structure, conduct and performance of the farm input industries. Initially, the work will focus on the analysis of farmers' buying practices for feed and fertilizer, utilizing data collected as a part of the 1966 Pesticide Survey. Editing and tabulation plans have been developed. A more detailed study has been developed in cooperation with the University of Illinois which will seek to identify service costs and scale economies implied by various purchasing arrangements for feed used by commercial hog producers. Among the hypotheses to be tested is that larger producers utilize substantially different sources of supply than do smaller producers, and can acquire their feed supply at lower cost. Questionnaires have been developed to obtain primary data from hog producers and from feed dealers, and field work has begun.

The Northeastern States has been selected as the site of an aggregative study of the interrelationships between the farm production, and the farm input and marketing, sectors. This region has been characterized by a sharp decline in the number of farms, in the acreages of cropland and

pasture, and in the number of family and hired workers. These trends in the farm sector have been accompanied by mergers and consolidations in the number of plants and firms providing farm inputs and marketing and processing facilities. The proposed study will seek to analyze past trends, analyze the present situation, and make projections of commercial agriculture for 1970 and later target dates. These projections will include the number and size of farms and their geographic distribution, the kinds and quantities of specific farm inputs implied by the projected production, and the implications of changing production patterns to marketing firms. A project outline to implement these objectives has been developed and sources of data and methodological problems have been explored. Cooperative working relationships have been developed with the University of Maryland.

A manuscript which examines the role of industry in agriculture and its impact on farming is currently under review. The report documents the extent to which the farm input and marketing sectors have altered, and are likely to continue to influence, the number and size of farms and the farm production process. The relative importance of inputs of nonfarm origin has increased steadily in recent decades as the farm supply industries have become the chief provider of new technology. These forces, together with the emergence of contractual arrangements with the marketing and processing sector, have spurred increases in farm size. Despite these forces, however, farms remain largely family owned and operated and little significant increase can be found in large-scale corporate farming.

Another report, now in press, analyzes changes in the age distribution of farm operators by economic class of farm. Excluding part-retirement and small commercial farms, the median age of farm operators is quite close to that of other self-employed workers. Furthermore, the average age of operators of farms grossing \$20,000 or more has remained almost constant for the past decade. Their level of educational attainment was substantially higher than for operators of smaller farms.

B. Economics of Farm Size and Numbers of Farms

The work of updating numerous measures of farm size contained in the various Census of Agriculture reports will be completed as State reports from the 1964 census become available. A special analysis of large-scale farms is in process, together with compilations of census data to show trends in the concentration of farm production by size of farm and by geographic areas. Several publications to present these data are planned.

A paper has been prepared which examines the impact of weather and technology on crop yields and net returns in the State of Washington. This was an extension of the work on economics of size of wheat-pea farms in Washington, now published. Weather patterns in the Palouse wheat area were analyzed using multiple regression techniques showing the relationship between meteorological variables, technology, and yields over the last 21

years. The results of this study were put into a probability framework and net returns were estimated based on the weighted value of the net return. Comparison of these results with those obtained from normative linear programming showed that the latter technique overestimated net returns on smaller farms. Further progress was made also in developing production functions for various varieties of apples grown in Washington to be used as guides for tree replacement planning and for study of the economies of size of orchards.

The initial objectives of the study of economies of size of dairy farms in Minnesota have been met, and 2 cooperative Experiment Station bulletins are in the review process. Work has shifted to a study of capital accumulation and growth for 6 representative farm situations to determine the potential earnings available to finance the transition to a parlor milking system. This system was found to be most efficient in the previous analysis. The model used for the analysis assumed a 10-year transition period with limited production alternatives, coefficients representing production conditions for 1968, and typical family consumption requirements from farm income. Smaller units were hard pressed to earn the minimum income needed for family living expenses. Larger representative farms could accumulate the necessary capital to finance the shift to a labor efficient system with 1-man operations. However, they could not achieve the 2-man size where most of the economies of size are realized.

The report of the North Carolina study of economies of size of tobacco farms is currently being reviewed for publication. Results indicate that cultural practices were quite similar for the 5 farm sizes, but prices paid for specific inputs such as labor were related to size of farm. When the same farms from a 7-county area were examined over a 10-year period to determine the characteristics of the farms that stayed in business compared with those that went out of business, few significant differences were found.

The Illinois study of size of corn and hog farms needed to achieve most efficient and profitable operation also is in draft form for review. The major findings of this study were reported in 1966. Some additional work has been done, however, to determine the effects of alternative levels of land values on farm organization and net returns to operator. Varying land values had little effect on the level of gross income needed to achieve minimum average costs, but residual returns to management and profits were reduced drastically with higher land prices. A 2-man cash grain farm with 8-row equipment produced \$53,279 for management and profit with land at \$491 an acre, but only \$6,141 with land at \$982 an acre. Higher land prices also resulted in higher costs of production on hog farms, but the overall effect was less than on cash grain farms as land is a smaller proportion of total resource requirements. Doubling of land values required a higher gross income for optimal size of farm, increased the relative importance of hogs, and reduced management earnings.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Vertical Coordination and Changing Structure

None.

B. Economics of Farm Size and Number of Farms

Madden, J. P. 1967. Economics of size in farming. Agr. Econ. Rpt. 107. Econ. Res. Serv. 83 pp.

Michalson, E. L. 1967. Economics of farm size in the Washington-Idaho wheat-pea area. Wash. Agr. Expt. Sta. Tech. Bul. 52. 18 pp.

Reinsel, Robert D. 1967. Changes in farm size. In Farm Real Estate Market Developments, Econ. Res. Serv. CD-69. 7 pp.

AREA NO. 4. FARM CAPITAL, CREDIT, AND FINANCIAL CONDITION

Problem. One of the most significant sources of change in farming in recent years has been innovation in the methods of acquiring access to the services of productive capital and land resources. Land and machinery are expensive and production technology continues to become more capital intensive. Operating costs continue to increase. In addition, many farmers -- both beginners and those already established -- seek to increase the size of their businesses to more effectively utilize available technology and to improve their incomes. Reflecting these forces, capital and credit usage have been rising sharply despite "tight" national credit markets and higher interest rates. In this environment, proper farm financial management has become a more crucial part of farming. Two kinds of studies are needed. On the one hand, it is important to document and to understand the changing financial and ownership structure of farms in major farming regions of the Nation, for these changes affect the trends in number and sizes of farms, the response of production to price and other economic variables, and the effectiveness of farm programs in achieving their stated objectives. On the other hand, continuous study is needed to keep abreast of the changing capital and credit requirements for various tenures, types, and economic classes of farms; to analyze how farmers accumulate the capital needed for their operations; and to determine the extent to which lending institutions and other credit sources are providing the amounts, types, and terms of credit for farmers' changing needs. The developing debt situation requires continuous appraisal. These various studies are needed for the guidance of farmers and lenders, and to aid policymakers and program administrators in improving farm programs.

USDA AND COOPERATIVE PROGRAM

The work in this area comprises a long-term program of statistical and economic research in 3 principal areas: The balance sheet of agriculture and financial outlook; improvement of farm-mortgage and short-term credit facilities; and farm financial management.

In Washington, D. C., the work on the balance sheet of agriculture and financial outlook involves chiefly the assembly and analysis of statistical data and other information pertaining to the financial and debt situation of farmers. The Division has become a clearing house for data on farm debts, to which the major lenders (or their supervisory authorities) report on their own loans to farmers and in return receive comprehensive information on the entire farm debt situation. In addition, the Division assembles data collected elsewhere in the Department and by some other agencies on farm assets and incomes and issues each year two analytical reports: (1) "The Balance Sheet of Agriculture," which measures and explains changes during the last year in the financial situation of agriculture; and (2) the "Agricultural Finance Outlook," which appraises current trends and

provides estimates of the farm financial situation for the next year. These publications contain the only available comprehensive analyses of the farm financial situation. Continuing efforts are made both to improve the statistics and other information used in the reports, and to provide more complete interpretation of the information.

As an aid in preparing the Agricultural Finance Outlook, surveys usually are made in the Fall to determine the views of farmers, representatives of credit institutions, and other knowledgeable persons concerning the current farm financial situation and prospects for the coming year.

In the work on improvement of farm-mortgage credit facilities, data from all available sources are assembled and consolidated in Washington, D. C., to determine the amount and distribution of farm-mortgage debt including land contract debt, the terms on which real estate credit is made available from the principal lenders, and trends in loan volume, repayments, refinancing, delinquencies, and foreclosures. Quarterly reports on the mortgage lending activities of the major life insurance companies, the Federal land banks, and the Farmers Home Administration (direct loans), are obtained and analyzed. In addition, the Census Sample Surveys of Agriculture provide periodic data on the distribution of mortgage debt among the various types, sizes, and economic classes of farms. The data from these activities are used in preparing the "Balance Sheet of Agriculture," and the "Agricultural Finance Outlook." They also are used regularly by the National Agricultural Credit Committee, which meets 3 times each year to appraise the farm-mortgage situation. The interest charge on the farm-mortgage debt is one of the elements used in determining parity prices, and is a cost item in computing net farm income. Numerous requests for data on the farm-mortgage situation are received each year from legislators, farm organizations, farm journals, the State Experiment Stations, individuals, and others.

In the research on short-term credit, statistical work in Washington, D. C., is similar to that done on farm-mortgage credit, that is, serving as an assembly point and clearing house for information on the non-real-estate credit used in agriculture, and analyzing and interpreting the data. The data from this part of the work have uses similar to those on mortgage credit, except that they are not used in computing parity prices of agricultural products.

A continuing major project is the analysis of data from the periodic Census sample surveys which contain comprehensive information on a national scale on both short-term and mortgage debt. These surveys also obtain information on farm and nonfarm incomes of individual farmers, on the owned and rented value of their farm real estate, on the tenure and type of farm, and on a number of other important items. The second sample survey conducted by the Census in late 1965 and early 1966 is being prepared for tabulation and publication by the Census. These data will then be analyzed by the Division in cooperation with other agencies.

Increasing capital requirements underscore the growing importance of financial management to individual farmers. Wise management is essential both to the beginning farmer and to the achievement of farm growth. Cooperative studies dealing with farm growth, its financing, and other aspects of farm financial management were started at 3 additional locations during the year -- at the Ohio, Nebraska, and Washington Experiment Stations.

Other cooperative work, continuing from the preceding year, includes the following: In Florida, a study of financial management of beef cattle farms; in Michigan, studies of savings, use of credit, and capital accumulation by Michigan farmers; in Indiana, a study of financial management in the growth of Indiana crop and livestock farms; and in Illinois, a study of changes in the value over time of fixed permanent investments made by farmers, especially when the investments are sold as a part of the entire farm.

Federal scientific man-years devoted to the work totaled 11.0 divided as follows: Balance sheet of agriculture and financial outlook, 1.4; improvement of farm-mortgage credit and short-term credit facilities, 3.8; and farm financial management, 5.8.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 5.7 scientist man-years is devoted to this area of research.

PROGRESS -- USDA AND COOPERATIVE PROGRAM

A. The Balance Sheet of Agriculture and Financial Outlook

Farm asset values reached \$269.5 billion at the end of 1966, an increase of \$13.8 billion from a year earlier. The gain of 5.4 percent was not as large as in the previous year but was more than double the average rate of other years since 1949 if the Korean War period, 1958, and 1965 are excluded. In each of these excluded years, the stimulus provided by a rally in net farm income pushed asset values up sharply, particularly land values. Excluding these years of sharply higher net farm income, gains in total asset values since 1949 still averaged about 2 percent per year.

Total farm debts, including Commodity Credit Corporation loans, increased by \$4.1 billion to \$45.7 billion in 1966. This dollar increase in debt was equal to the record rise in 1965. With the value of farm assets rising by a much greater amount than debts, owner-equities rose by nearly \$10 billion in 1966, and reached \$223.8 billion on January 1, 1967.

Owner-equities continue to represent a large portion -- 83 percent -- of total farm assets. The increase during 1966 represented the seventh consecutive year that owner-equities gained. In only 4 years since 1940 have ownership equities declined.

Estimates show that over 90 percent of the increase in total asset values in 1966 was due to price increases. Gains from price increases amounted to \$13.8 billion compared to net tangible additions to the physical resources of the agricultural sector of about \$0.7 billion. Since the early postwar years, price increases have probably added more than \$120 billion to the value of farm assets while real additions to agriculture's physical plant have amounted to about \$20-\$25 billion when valued in 1947-49 dollars. Thus, 1966 increases in total asset values follow the same pattern as in the past two decades, in which most of the gain was associated with higher prices and real capital accumulation accounted for a small portion of the total increase. Relatively small net additions to the stock of physical capital occur because annual depreciation and obsolescence are estimated to be nearly as large as gross outlays for investment in new plant and equipment.

The total value of farm real estate rose nearly 6 percent during 1966. And, as farm real estate accounts for about two-thirds of all assets listed in the balance sheet, this source alone accounted for over 70 percent of the \$13.8 billion gain in total assets in 1966. The sharpest increases in land values per acre -- over 10 percent -- occurred in the Midwest and in many southern States while the smallest gains occurred in the northern dairy States, and in some western States. Regional patterns of change in land values provide indications that farm capital gains have not been evenly distributed over the country. Furthermore, not all of the gain in farm real estate values is received by farm operators. Nearly two-fifths of the value of all farm real estate is owned by nonfarm landlords.

The data now shown in the balance sheet are a national aggregate of the values of all farm property and the amount of all farm debt in the Nation. Using data obtained in the 1965 Pesticides Survey, work has been started toward preparation of balance sheets on a less aggregative basis than is now done. For example, it may be possible to prepare balance sheets by economic class of farm or by region.

B. Improvement of Farm-Mortgage Credit and Short-Term Credit Facilities

The tight money situation in 1966 affected agriculture both by reducing the availability of credit from some lenders and increasing the cost of borrowing. The reduced availability of credit was particularly pronounced in the farm-mortgage credit field during the last half of the year, and it continued into 1967. During the third and fourth quarters of 1966, farm mortgage loans made by life insurance companies decreased 42 percent from the same period a year earlier. Loans made by the Federal land banks decreased 6 percent in the same yearly comparison. Mortgage loans made by individuals increased.

In contrast to mortgage debt, non-real estate farm debt continued to expand throughout the year. In early 1967, outstanding debt (excluding CCC loans) exceeded the year-earlier level by 12 percent. All major non-real estate

lenders expanded their outstanding loans by a greater amount in 1966 than during the previous year.

Total farm debt (excluding CCC loans) increased \$4.3 billion to \$44.5 billion in 1966. The increase was about equally divided between gains in non-real estate and in real estate obligations. The increase was associated with record outlays for production inputs, farm capital expenditures, and the need to finance real estate transfers at record high prices. The record increase in debt during a year marked by tight credit indicated that the group of lending institutions and other credit sources serving agriculture were able to compete effectively for the limited supply of loan funds.

Interest rates on farm-mortgage loan commitments of life insurance companies increased from 5.8 percent in the last quarter of 1965 to 6.6 percent in the last quarter of 1966. By September of 1966, all of the Federal land banks were charging 6 percent, the maximum permitted by existing legislation. The Federal intermediate credit banks, because of the sharp rise in the cost of their borrowed funds, raised their discount rates by $\frac{3}{4}$ to $1\frac{1}{2}$ percentage points during 1966. This, in turn, caused many production credit associations to increase the rates which they charged their farm borrowers. Average interest rates charged by commercial banks on all types of agricultural loans were generally higher in 1966 than in the previous year.

Largely because of the continued need to enlarge farms, farm-mortgage credit and land rental arrangements are widely used. Partly as a result, financial interests in farmland have changed. Nonoperator financial interests represented by claims of landlords and creditors in farm real estate have increased in recent years, rising from about 47 percent in 1950 to 53 percent in 1967. As capital requirements per farm continue to mount, and depending in part upon net returns from owning real estate, nonoperator financial interests may become larger.

As part of an overall study of the current characteristics of agricultural debt, the Division is cooperating with the Board of Governors of the Federal Reserve System and the Farm Credit Administration in analyzing the 1966 outstanding farm loans of several important lenders. The major life insurance companies (holders of about 95 percent of all life insurance company loans secured by farm mortgages) cooperated in the survey of their farm-mortgage loans. The survey information will form the basis of a study of the characteristics of their farm-mortgage loans. The 12 Federal land banks supplied similar information for a study of Federal land bank loans. The 2 studies -- of farm-mortgage loans of the life insurance companies and of the Federal land banks -- will include comparisons of the current characteristics of farm-mortgage loans with the characteristics of the loans held by the same 2 lenders in 1956 when an earlier survey was reported by the Department.

Other phases of the Department's participation in this overall credit study are analyses of the operating loans and the farm-mortgage loans of the Farmers Home Administration (FHA-USDA). These studies will show the kinds of borrowers served and the kinds of loans made by FHA-USDA, as compared with those of commercial lenders such as banks and production credit associations (short-term loans) and life insurance companies and the Federal land banks (long-term loans). The studies will seek to establish whether FHA-USDA mainly fills gaps in farm credit needs left by existing credit institutions, or whether FHA-USDA competes with existing institutions.

The Census has provided preliminary State data from the 1964 Census of Agriculture showing the mortgage debt status and the amounts of debt owed to "non-reporting" creditors by farm owners (non-reporting creditors do not supply farm-mortgage loan data to the Division). These data and data from the 1966 Sample Survey of Agriculture are being used for the 5-year revision of the Department's farm-mortgage debt figures.

In Missouri, data pertaining to housing and use of credit for a sample of 200 people who bought or built rural homes in 6 Missouri counties without financial assistance from the Farmers Home Administration were analyzed and a manuscript was prepared. This manuscript was combined with one prepared earlier which dealt with the use of rural home construction loans by FHA-USDA borrowers in 12 Missouri counties. Findings from this research indicate that the FHA-USDA rural housing credit programs were helping many low-equity borrowers obtain better housing which they could not have financed otherwise.

A study of the rural capital and credit markets of Mineral and Preston Counties, West Virginia, is in manuscript form. Comparisons between the 2 counties reveal some of the relationships between characteristics of the local credit markets and the various aspects of economic growth. One noteworthy finding was the very great dependency of relatively isolated rural areas on commercial banks for credit.

C. Farm Financial Management

A Washington, D. C.-based study of farm financial management, initiated in late 1966, has been developed into an integrated program of research. The objectives of this research program are to identify and evaluate problems of farm financial management encountered by farmers in important type-of-farming situations; to develop guidelines and procedures for resolving these problems; and to evaluate the aggregate implications of the financial management strategies and adjustments of farmers. Progress during the past year includes development of concepts for separating the returns to the operator, landlord, and investor functions or roles in agricultural production. This allows the farmer to determine where his returns are greatest and thus what investment strategies permit the most rapid attainment of financial goals. In addition, a conceptual framework is being developed

within which several complementary field-based studies can contribute to a consistent and complete "research package."

In Florida, data have been collected for a study of the development, operation, and financial management of beef cattle production units. A stratified random sample of beef cattle (cow-calf) producers was drawn from a list of the total number of beef cattle producers in central Florida. The field enumeration was completed and the schedules are being edited. The field schedule obtained information for 1966 on resource inventories, livestock inventories, enterprise organization, and financial management practices on the sample units.

The purpose of a new study in Ohio is to learn more about the process of farm firm growth. A hundred cash grain-hog farmers in 6 southwestern Ohio counties will be interviewed to collect data on attitudes, management ability, and amount of growth during the past 5 years. From these 100 operators, several will be selected for intensive interview on growth strategies and problems. The initial survey schedule has been developed and pre-tested and data collection has begun.

Further progress was made on 2 studies of financing growth and financing large-scale farming operations on dairy farms in Michigan. From one study, preliminary drafts of 2 manuscripts have been prepared. The manuscripts deal with management and financial problems in expanding to large-scale dairy farming. The data were obtained from a sample of farmers who had expanded from small dairy herds to 70 cows or more during the period 1957 to 1965. The research has revealed many important aspects of financing expansion to large-scale dairying. For example, it has shown the importance of appropriate repayment terms. Often repayment terms need to be lengthened. Three- and 4-year loans on equipment require that the farmer make a very high rate of return (30-40 percent per year) in order to have a self-liquidating loan. In a similar manner, an attempt to repay real estate credit in too short a time period can severely restrict the capital a farmer can retain for operating or working capital purposes. The second study has focused more on the effects of credit and capital control alternatives on the growth of dairy farms. Data have been obtained from farm management records of Michigan farmers. A related project has involved use of the Michigan farm management records to compare the returns from farming with what these farm operators could have received for their labor and capital investment in alternative uses. This will furnish an indication of parity returns by type and economic class of farm as well as the variation associated with each group.

Work is continuing at Southern Illinois University on a study aimed at appraising the influence of internal and external capital rationing on the abilities of farmers to build up their farms to approach optimum size and efficiency. A quarterly recursive programming model was used to simulate growth patterns for grain-hog farms for 9 different beginning farm situations. The findings indicate, among other things, that greater opportunities

for expansion and growth exist if leasing is used as a means of gaining control of capital resources.

Survey schedules have been developed for a study of farms in eastern Washington to ascertain the major problems in the financial management of investments in machinery and other intermediate-term capital resources. For the survey farms, management of cash flows will be analyzed to determine optimum intermediate-term investment patterns and to determine the important problem areas in farm equipment financing.

At Purdue University, a simulation model is being developed to test the effects of initial resource position, leasing, enterprise preference, managerial ability, and land and labor prices on rates of farm firm growth.

In Illinois, progress was made on a study of economic considerations involved in the addition of large fixed assets to beef feeding farms in the Corn Belt. A method for valuing a fixed asset, such as a mechanized feeding barn, was formalized and used in budgeting costs and returns for several farm alternatives. It was found that with less than 1,000 head of feeder cattle, it is not profitable to invest very much in feeding facilities unless management is such that a raise in grade can be obtained between feeder and finished cattle.

Studies were initiated in Nebraska and Illinois to analyze the processes, problems, and implications of farm firm growth.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Balance Sheet of Agriculture and Financial Outlook

Farm Production Economics Division. 1966. 1967 agricultural finance outlook. AFO-6. 36 pp.

Wall, Norman J., Allen, Philip T., Herr, William McD., Jones, Lawrence A., Reinsel, Robert D., and Warren, Forest G. The balance sheet of agriculture, 1967. Agr. Inf. Bul. 329. 40 pp.

B. Improvement of Farm-Mortgage Credit and Short-Term Credit Facilities

Evans, Carson D. and Warren, Forest G. 1967. Farm credit and tight money in 1966-67. Agr. Fin. Rev. 28. pp. 1-13.

Farm Production Economics Division. 1966. Farm-mortgage debt. FMD-5. 7 pp.

Farm Production Economics Division. Farm-mortgage lending experience of 20 life insurance companies, the Federal land banks, and the Farmers Home Administration:

March 1967. FML-17. 12 pp.

August 1967. FML-18. 22 pp.

Farm Production Economics Division. 1967. 1966 Agr. Fin. Rev. Vol. 27 Sup. 84 pp.

Farm Production Economics Division. 1967. 1966 Agr. Fin. Rev. Vol. 28.

Herr, William McD. 1967. Understanding changes in non-real-estate farm debt. Agr. Fin. Rev. Vol. 28.

Williams, Dorwin. 1966. New developments in the rural housing credit programs of the Farmers Home Administration. Agr. Fin. Rev. Vol. 27. pp. 48-53.

C. Farm Financial Management

Bailey, Warren R. 1967. Necessary conditions for growth of the farm business firm. Agr. Econ. Res. 19(1), pp. 1-6.

Bailey, Warren R. 1967. Organizing and operating dryland farms in the Great Plains. ERS-301. 55 pp.

Bailey, Warren R. 1967. What's ahead in GP-2? Proceedings of seminar on economics of firm growth. Agr. Expt. Sta. S. Dak. State Univ. Bul. 541. pp. 143-150.

Irwin, George D. 1966. Discussion: Firm growth research opportunities and techniques. Jour. Farm Econ. 48(5). pp. 1531-1535.

AREA NO. 5. AGRICULTURAL RISKS AND INSURANCE

Problem. Risk bearing is a necessary and costly function of ownership and management in farming because of personal and property risks, production hazards, and price uncertainties. The problem has become more complex in recent years because of rising capital investments, higher cash outlays, use of more credit and increased mechanization. In addition, the increased frequency of lawsuits has made farmers aware of greater personal liabilities. More knowledge is needed as to kinds and importance of farm risks, how they vary among areas and individuals, and the most economical way of dealing with them. Eliminating hazards, enlarging or diversifying operations, changing financial practices or business organization, or transferring risks to others are some of the methods that may be used under different circumstances. Special attention should be given to insurance and insurance institutions. In recent years many new types of property, personal, and liability coverages have been developed which should be appraised with respect to their value in insuring farm risks.

USDA AND COOPERATIVE PROGRAM

A continuing program of economic and statistical research is carried on that involves compilation of data on farm accidents, fire losses, crop insurance, farm and personal insurance, social security, and farmers' insurance companies. Analyses are made of the characteristics and the causes of farm fire losses and accidents, the impact of various types of insurance on agriculture, and the effect of social security programs on farm people.

Study is made of (1) the incidence of production risks, as reflected by yield variability and other factors, on the structure, functioning, and growth of farm firms, and (2) various methods of risk bearing that provide guides for decisions on feed and cash reserves, geographical dispersions of production, flexibility of organization, depreciation and tax management, and insurance.

Work is done in Washington, D. C. with informal cooperation of the Federal Crop Insurance Corporation, the Bureau of Old Age, Survivors, and Disability Insurance, insurance trade and statistical associations, farmers' mutual insurance companies and State insurance commissioners. Work in Montana is done with formal cooperation of the Experiment Station and with a Great Plains regional committee studying Federal Crop Insurance. A study of the problems of risk and financial management involved in dairy farm adjustments is continuing in Pennsylvania with formal cooperation of the Pennsylvania Experiment Station.

The program currently involves a total of 3.0 Federal scientific man-years: Improvement of farmers' mutual fire, windstorm, and crop-hail insurance

company operations, 0.4 man-years; organized farm fire protection and estimation of annual fire losses, 0.1 man-years; casualty and life insurance, social security, farm income variability and losses, and accident prevention, 1.5 man-years; and analysis of risks and risk bearing in agricultural production, 1.0 man-years.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 1.2 scientist man-years is devoted to this area of research.

PROGRESS -- USDA AND COOPERATIVE PROGRAM

A. Improvement of Farmers' Mutual Fire, Windstorm, and Crop-Hail Insurance Company Operations

A survey of farmers' mutual insurance companies suggests that most farm fire and lightning losses are relatively small; however, large fires cause most of the damage. In 1966, nearly one-third of the loss payments involved less than \$20, and another half resulted in payments of \$20 to \$199. Only 16 percent of the payments amounted to \$200 or more. Nearly half of the payments resulted from fewer than 2 percent of the fires -- those involving \$5,000 or more.

A study of crop-hail insurance company operations reveals that some of them are experimenting with "all-risk" and "weather perils" crop insurance in Illinois, Indiana, and Iowa. One Illinois company insures corn and soybeans grown for grain. The company restricts the number of policies it will accept in any one county, insurance covers only about half the value of the crop, and there is a 50-percent deductible. So far, loss experience has not been very favorable, and it may prove difficult to develop a widespread, private all-risk insurance that is profitable to insurers and attractive to farmers. Regular crop-hail operations were favorable to companies in 1966. Loss payments were only slightly more than half the amount of premium receipts.

B. Organized Farm Fire Protection and Estimation of Annual Fire Losses

Farm fire and lightning losses were estimated at \$198 million in 1966. This record loss was nearly 6 percent greater than in 1965 and about 3 percent higher than the previous record of \$193 million in 1964. Greater losses in recent years seem to reflect higher property values, although there have been years in which fire loss rates apparently increased.

C. Casualty and Life Insurance, Social Security, Farm Income Variability and Losses, and Accident Prevention

An analysis of the relatively new "farmowners" insurance package reveals that it is spreading rapidly among commercial farmers and that 15 percent of U. S. farms had this coverage at the end of 1966. Such insurance is

most prevalent in the Corn Belt and least important in the Northeast, Pacific, and Delta States. Only about 40 percent of all farms qualify for the farmowners policy because it is usually limited to owner-controlled farms and those with dwellings valued at \$8,000 or more. Premium cost per \$100 of protection is lower under the policy but total expenditure generally increases because of more coverage.

Continued study of fatal accidents on farms shows that those involving machinery increased from 35 percent to 41 percent of the total number between 1954-59 and 1965. Individuals aged 15 to 19 and 45 to 70 accounted for relatively more machinery fatalities in 1965 than did other age groups. Drownings and firearm accidents were next in importance to machinery accidents, accounting for 16 percent and 10 percent, respectively, of all accidental deaths on farms in 1965. The total number of farm fatalities was comparatively stable during 1955-1965, ranging from a high of 2,482 in 1955 to a low of 2,246 in 1962.

An analysis of farm social security tax returns shows that the number of individuals reporting farm self-employment for social security purposes on Schedule F declined from 1,859,000 in 1960 to 1,542,000 in 1965. About 13 percent of the individuals reporting in 1960 and 26 percent of those reporting in 1965 reported net earnings of \$4,000 or more.

A study of Federal farm income tax returns shows that farming is a source of income for more than 3 million individual proprietors, partnerships, and corporations. Income tax returns provide information on both the farm and off-farm income of individuals; this is important since most individuals with farm income apparently receive some off-farm income, and many receive most of their income from off-farm sources. About half of the individuals with farm income, including joint returns of husbands and wives, reported wages or salaries in 1963. Wages and salaries totaled \$7.1 billion and accounted for 62 percent of the off-farm income.

D. Analysis of Risks and Risk Bearing in Agricultural Production

A simulation model has been developed to study financial management under the uncertainties of dairy farm operation in Pennsylvania. When fully tested, the model will be used to predict the outcome of selected practices such as borrowing, use of insurance and reserves, and operation under different asset compositions. A crop insurance subroutine has been recently added to the model which will show the insurance cost and indemnity payments expected for various levels of production under conditions of uncertainty.

A study in Michigan relating borrower characteristics to good or poor farm loan experience indicated that the traditional debt-asset ratio was of little use in predicting risk of loan default. This finding suggests that lenders use the debt-asset relationship mainly to measure the safety of the loan rather than to indicate the future repayment ability of the borrower.

Longtime yield histories of 20 years or more have been completed for a sample of individual farms in 25 major wheat-producing counties of Montana.
The variability and levels of yields of these series will provide a basis for further study of production risks under dryland conditions.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Improvement of Farmers' Mutual Fire, Windstorm, and Crop-Hail Insurance Company Operations

Jones, Lawrence A. 1967. Crop-hail insurance 1965, volume, cost, indemnities. ERS-342. 9 pp.

B. Organized Farm Fire Protection and Estimation of Annual Fire Losses

Reinsel, Edward I. 1967. Farm property losses from fire. Mimeographed. 5 pp.

C. Casualty and Life Insurance, Social Security, Farm Income Variability and Losses, and Accident Prevention

Botts, Ralph R. Rev. 1966. Farmers' handbook of financial calculations and physical measurements. Agr. Handbook 230. 56 pp.

Jones, Lawrence A. and Reinsel, Edward I. Rev. 1967. Insurance facts for farmers. Farmers Bul. 2137. 23 pp.

Jones, Lawrence A. 1967. Insurable property values in a changing agriculture. Farm Production Economics Division. Unnumbered. Mimeographed. 10 pp.

Jones, Lawrence A. 1967. The farmowners insurance package. Agr. Fin. Rev. 28. pp. 14-22.

D. Analysis of Risks and Risk Bearing in Agricultural Production

Hutton, Robert F. 1966. A general agricultural firm simulator. Penn. State Univ. Mimeographed. 65 pp.

Montana Agricultural Experiment Station. 1967. Crop insurance in the Great Plains. Mont. Agr. Expt. Sta. Bul. 617. 96 pp.

Reinsel, Edward I. and Brake, John. 1966. Borrower characteristics related to farm loan repayment. Mich. Agr. Expt. Sta. Res. Rpt. 59. 6 pp.

AREA NO. 6. FARMLAND VALUES AND VALUATION

Problem. Farmland and buildings is the largest single productive asset in agriculture, with a market value of \$182 billion on March 1, 1967. Trends in market values of this asset, and reasons for such changes, are of continuing interest to landowners, prospective purchasers, public and private credit institutions, industries serving agriculture, local governmental units and Federal agencies. Both public and commercial lenders need current information regarding both current and prospective trends in land prices as a guide for formulating and modifying their appraisal and credit policies. Farm programs often have widespread and pervasive effects on land values, and changes in programs need to be continually evaluated regarding such effects.

Market prices of farm real estate have risen almost without interruption since the early 1940's. During the 1950's, this rise was viewed by many as a paradox because of the apparent lack of support from farm income. New economic forces emerged which appeared to obviate the traditional historical relationship between farm earnings and land prices. Some of these could be found within the agricultural sector, such as the rapid adoption of new production technology and the expansion of farm operating units, and others were clearly attributable to developments in the nonfarm economy. Forces outside the farm firm have increasingly become partial determinants of land prices over wider geographic areas as metropolitan areas continue to grow and as improved transportation facilities expose larger areas to the impacts of population growth. Present and potential demands for land as space, rather than solely as a productive resource for agricultural uses, need to be more adequately recognized if useful and realistic projections are to be made of future trends in land prices.

USDA AND COOPERATIVE PROGRAM

The work involves a continuing program of research designed to obtain current information on various aspects of the farm real estate market at the State and national levels. Statistical series are developed and maintained to measure periodically changes in market prices of farm real estate, rates of farm transfers by various methods, sources and terms of credit used to finance land transfers, and sources of the demand for, and supply of farmlands that come on the market. Two surveys are directed annually to farm real estate brokers and other informed people to obtain such basic information. These data, together with the estimates of market values obtained from USDA crop reporters, are summarized and analyzed in periodic reports issued twice a year. Increased attention has been given in recent years to the rural nonfarm sector of the land market, including sales of farms for nonfarm uses and prices of land for various recreational uses.

The current-developments phase of the research program outlined above is supplemented by special studies on selected aspects of the rural land market such as farm building valuation, determination of a cost basis for farms, and alternative measures of land earnings. Liaison is maintained with Federal and private credit agencies and with private farm real estate sales and management organizations, by which survey and research results are made available to them in exchange for the information they provide.

The Washington-based research program is supplemented from time to time with cooperative studies with State Experiment Stations in which specific facets of the farm real estate market are studied in greater depth than is possible at the national level. Four such studies are currently in progress. Three of these (in South Carolina, Louisiana, and California) are concerned with market prices of land used for cotton production and with the factors associated with the variations found in land prices in the study areas. These studies also will provide a basis for establishing alternative methods for estimating an annual land cost for use in the Division's study of costs of producing cotton. The fourth study, in cooperation with the University of Nebraska, obtained information on buyers and sellers, financing, and the complementary relationships between the land purchased and the size and organization of the farm operated by the buyer before and after purchase.

Annual estimates of gross and net rents paid for rented land represent another continuing research project at the national level. Such estimates are needed in calculating net income of farm operators by USDA and are incorporated in the national income accounts of the Department of Commerce. Rents also provide an independent measure of rates of return to farmland and are a useful analytical tool in the continuing study of land prices.

About 4.1 Federal scientific man-years are currently devoted to all phases of the research program in farmland values and valuation. Of this total, about 1.5 man-years are allocated to the current-market-developments phase of work, and 2.3 man-years to analysis of factors affecting land values and transfers. Lack of personnel limited work on farm real estate rentals to 0.3 man-years.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 5.4 scientist man-years is devoted to this area of research.

PROGRESS -- USDA AND COOPERATIVE PROGRAM

A. Current Developments in the Farm Real Estate Market

The advance in market prices of farm real estate slowed somewhat in the Fall and early Spring of 1966-67. The national index of average value per acre for March 1, 1967 at 160 (1957-59 = 100) was 3 percent above November 1, 1966, and 7 percent higher than a year earlier. Small declines occurred in 6 States in the latest 4-month period, notably in California and Florida

where lower prices for citrus groves pulled down the all-land average. Market prices continued to increase in the Corn Belt and Northern Plains States, although the rate of increase was a little less than in the same period a year earlier.

The total market value of farm real estate advanced to \$182 billion on March 1, 1967, up nearly \$10 billion from a year earlier. This is equivalent to \$167 per acre and \$63,000 per farm operating unit.

Although the number of farms offered for sale in 1966-67 remained about the same as in previous years, effective demand for land was dampened somewhat by the reduced supply of credit available from commercial sources and the increase in interest rates. More frequent use of installment land contracts partly offset the tighter supply of farm-mortgage credit. Interest rates in the Fall of 1966 averaged 6.4 percent for commercial banks, 6.0 percent for Federal land bank mortgages and seller contracts, and 6.6 percent for insurance company loans.

Voluntary transfers of farm real estate were at the rate of 31.1 per 1,000 farms in the year ended March 1, 1967, the same as for the previous year. the total number of transfers was estimated at about 114,000 containing about 26 million acres of land, and had a sales value of \$5.3 billion. Nearly 45 percent of the tracts and farms sold were less than 100 acres in size; 73 percent contained less than 180 acres. More than half of all tracts sold (58 percent) were bought to enlarge existing farms. Two-thirds of all buyers were active farmers and 60 percent of these buyers purchased land to increase their volume of business. As in past years, sellers are predominantly quitting farming to retire or to take nonfarm jobs.

B. Analysis of Factors Affecting Land Values and Transfers

The proportion of cropland and the size of tract were found to be important characteristics affecting sales prices of land. An analysis of about 8,000 land transfers from the October 1965 survey showed a nearly straight-line percentage relationship between increases in the percentage of cropland and the sales price per acre. Nationally, tracts having less than 10 percent of cropland sold for an average price of \$46 per acre, whereas tracts consisting of 90 percent or more of cropland sold for \$368 an acre. Similar relationships were found for each production region and at the State level. With respect to size of tract, it was found that sales prices per acre decline rather consistently as size of tract increases. Part of this relationship is due to the tendency for larger tracts to have a smaller percentage of cropland than do small tracts. But even when both cropland and size are taken into account, smaller tracts sell for more per acre than do large tracts.

Imputed returns on the market value of farm real estate in 1966 were the highest since the early 1950's. After allowing for a return to operators' labor and management and a return on non-real-estate capital, the net

returns to farm real estate were estimated at 5.1 percent on market value in 1966, compared with 4.8 percent in 1965. The continued decline in number of farms and in labor requirements permitted a larger share of total earnings to be allocated as a return to real estate. This share was estimated at 36 percent of total earnings in 1966, compared with an average of 25 percent for the 1960-64 period. The share allocated to operators' labor has declined, but has increased in dollar terms because of fewer farms.

Analysis of land sales data in the South Carolina Coastal Plain showed that prices ranged from \$20 to \$526 an acre. Of the 91 transactions studied, 56 had both cotton and tobacco allotments and averaged 68 acres in total size. The average sales price for this group was \$132 an acre, compared with \$73 an acre for tracts having only cotton allotments. About three-fourths of the buyers owned other farmland at the time they bought the sample tracts. Two-thirds of the buyers said their primary reason for buying was to increase the size of their farms or acreage allotments. Buyers who were farming the purchased tracts in conjunction with other land paid higher prices per acre and bought larger tracts than non-add-on buyers.

Several linear regression models were developed to explain variations in selling prices. The significant independent variables were found to be: (1) Total acreage in the tract, (2) percentage of tract that was open land, (3) historic cotton production on the tract, (4) historic tobacco production on the tract, (5) distance from county seat, (6) percent of purchase price borrowed, and (7) age of buyer. The first 5 of these factors explained 94 percent of the variability in price per tract. Additional analysis will be included in a report now being prepared.

A similar study of land transfers in the Mississippi Delta is nearing completion. It will be based on about 1,000 land transfers in 17 Delta counties in which 500 buyers were interviewed. As in the South Carolina study, wide variability was found in both prices paid and in size of tract transferred. About three-fifths of the tracts bought were added to existing farms, one-fifth were being rented out by the buyer, and one-sixth were operated as complete farm units. More than three-fourths of the buyers owned farmland prior to the purchase.

In addition to obtaining information regarding the characteristics of the land transferred and the buyer and seller, considerable attention was given to determining average values for major land components. Use of a multiple regression model resulted in an average value of \$225 per acre for open land, \$85 for woodland, and \$300 per acre for cotton allotment. Considerable variation in sales prices was not explained by the variables included in the regression model. Nonmeasurable factors such as intensity of desire on the part of buyers, lack of knowledge on the part of both sellers and buyers, and qualitative considerations such as topography, drainage and estimated productivity also contributed to the variability in sales prices.

Field work has been completed in California and regression analysis of land sales data is nearing completion. This study is based on recent land purchases in portions of Tulare and Imperial Counties where cotton is an important crop. As was true of the other two studies, variability in sales prices has been difficult to explain by means of a regression model. Time was found to be a significant variable, as well as soil quality. Analysis of Imperial County data where nonfarmers are active as land buyers suggests that such buyers paid significantly higher prices per acre than local farmers.

The first phase of the Nebraska study has been completed and a separate report as well as several short articles are awaiting publication. The bulletin, summarizing a survey of 231 sales of farm real estate in 5 areas of the State in 1966, will show that 82 percent of the buyers were active farmers who were operating larger than average farms before they bought the additional land. The land bought was typically 80 or 160 acres and had been operated as a part of a larger farm prior to sale. Thus, the majority of land sales involved a shift in acreage of land from one farm to another, rather than in the absorption or consolidation of separate farming units. About one-fourth of the buyers paid all cash for the land they bought, one-fifth entered into a purchase contract with the seller, and the remainder used some form of mortgage financing. The Federal land bank and life insurance companies were the chief sources of farm mortgage funds.

An article has been prepared for the "Nebraska Quarterly" which compares the major characteristics of buyers and sellers in the 1966 survey with a previous study made in 1957. Characteristics and occupations of buyers were found to be remarkably similar. However, a higher percentage of the buyers in 1966 were in the 35-54 age group than in 1957. A majority of the sellers in 1966 lived in a city at the time of sale, compared with only 29 percent in 1957.

C. Agricultural Rents

Gross rents were estimated at \$4.3 billion in 1966, about 8 percent more than in 1965. This increase was substantially more than the increase in landlords' expenses, with the result that net rental returns were up 13 percent. In addition to the calculation of national rent estimates, further work was completed on the refinement and extension of the special rent estimates for use in the ERS income parity study. The imputed net rental return to owner-operated farms, based upon the alternative of cash and share rental returns, was 5.7 percent on the market value in 1965.

A new cash rent series for cropland was initiated in 1967 in recognition of the apparent increase in this method of land rental. These data have been summarized, along with previously collected data pertaining to cash rental rates for farms, and are in process of publication. They show that, in general, cash rents have increased at about the same rate as market values of lands over the past decade. Cash rents for cropland ranged

between \$30 and \$40 an acre in the central Corn Belt in 1967, and as high as \$60 to \$70 an acre for cotton land in California.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Current Developments in the Farm Real Estate Market

Economic Research Service. 1967. Farm real estate market developments. CD-69. 39 pp.

B. Analysis of Factors Affecting Land Values and Transfers

None.

C. Agricultural Rents

Economic Research Service. 1967. Method of estimating net rental returns to farmland and ratios of net rents to value of farm real estate, in parity returns position of farmers. Senate Doc. No. 44. 57 pp.

AREA NO. 7. ECONOMICS OF FARM PRACTICES AND TECHNOLOGY

Problem. New and rapidly changing technology is having profound effects on agriculture. Ever-changing conditions of production brought about by new machines, new-type structures and related equipment, and improved methods of crop and livestock production require continual economic study to provide farmers, policymakers, and industries serving agriculture with guidelines for decision in a changing economic environment. Such studies need to measure, and keep abreast of, major changes in farming technology and must appraise the implications of these changes for the future. These studies should include analyses to provide information needed by farmers in different situations as they adjust to changing conditions of technology, prices, and costs. They should also include analyses aimed at guiding policymakers and program administrators as well as at helping industry to meet better the needs of farmers.

USDA AND COOPERATIVE PROGRAM

This research consists of a continuing program of collection and analysis of data bearing on national situations and of the study of certain important innovations in farm practices and technology. Included is the development of aggregative measures of the effects of technological changes on farm output, costs and income.

More specifically, the work involves the collection of pertinent data and the economic analysis of developments in farm mechanization and structures; in the use and effects of fertilizer, pesticides, and related crop practices; and in the production and utilization of livestock feed. These activities center in Washington, D. C. and consist mainly of broad national studies dealing with both the supply aspects and the demand aspects. They usually involve at least informal cooperation with other USDA agencies, particularly the Statistical Reporting Service and the natural science and engineering groups dealing with mechanization, crop practices, and livestock feeding.

Research results are normally presented in aggregative terms for areas, States, or regions, along with supporting data such as input-output ratios. Intensive studies of narrower scope are made occasionally in selected areas to obtain information to supplement national and regional data from other sources. Such studies are usually in cooperation with State Experiment Stations, currently in California, Iowa, Michigan, Missouri, and Nebraska.

The manpower currently devoted to this program is estimated at 7.9 Federal scientific man-years, allocated as follows: 5.2 on economics of pesticide use in agriculture, 1.4 on economics of feed use and feed livestock relationships, 0.2 on economics of farm mechanization and associated techniques, 0.8 on inventory and analysis of production practices (national), 0.3 on

economics of fertilizer use and crop technology, and none on economics of farm structures and materials handling.

PROGRAM OF STATE EXPERIMENT STATIONS

No scientist man-years reported.

PROGRESS -- USDA AND COOPERATIVE PROGRAM

A. Economics of Pesticide Use in Agriculture

The recently initiated research on the economics of pesticide use in agriculture is moving ahead in 3 major phases: (1) Nationwide surveys of farmers to obtain data on costs and practices to control plant and animal pests; (2) economic analyses of selected alternative methods of pest control on farms with emphasis on innovations to control pests; and (3) analyses of the aggregate economic implications of alternative methods of pest control for agriculture as a whole.

The initial tabulations from the 1964 Nationwide Pesticide Survey were completed. Information related to expenditures for pesticides was published early this year. Work is progressing on 3 additional reports: (1) Pesticide expenditures by crops and by regions by functional use of the pesticide; (2) quantities of technical materials used by farmers grouped by crops and livestock; and (3) the number of self-propelled and power-take-off sprayers operated by farmers, and the extent of custom spraying and leasing of sprayers.

The field work for the 1966 Pesticide and General Farm Survey has been completed. In addition to information on the use of pesticides by farmers, supplementary data were collected on feed, fertilizer, changes in size of farm, land tenure, water management, farm income, nonfarm income, expenses, assets and debts. The data are being edited and tabulations will begin late in 1967. About 10,000 questionnaires were enumerated from farmers in 417 counties of 47 States. As in the previous survey, Hawaii and Alaska were not included and the probability sample did not result in any farms being drawn in Rhode Island. This survey, in contrast with the 1964 survey, includes all sizes of farms. The sampling procedure resulted in roughly a sample of a quarter of one percent of the farms with gross sales of less than \$10,000, one percent with gross sales of \$10,000 to \$240,000, and 2 percent with gross sales of \$40,000 or more.

Preliminary indications from the 1964 survey, shown in the accompanying table, are that farmers used about 458 million pounds (technical basis, 100 percent active materials) of specially formulated chemical products to control crop and livestock pests in 1964. In addition, they used about 313 million pounds (approximately 4.5 million gallons) of petroleum, primarily as a pesticide, but to some extent also as a solvent and mixing agent. The major share of the pesticides was used on crops -- about 93 percent by

Quantities of pesticides used by farmers in the United States, 1964

Type of pesticide product	Pounds of active ingredients			
	Total	Crops <u>1/</u>	Livestock	Other <u>2/</u>
	<u>pounds</u>	<u>pounds</u>	<u>pounds</u>	<u>pounds</u>
<u>Fungicides</u>				
Sulfur.....	136,823	135,228	404	1,191
Other inorganic.....	9,327	9,264	47	61
Total inorganic.....	146,150	144,492	451	1,207
Organic.....	23,929	21,451	2,375	103
Total fungicides.....	170,079	165,943	2,826	1,310
<u>Herbicides</u>				
Inorganic.....	10,434	9,565	---	869
Organic.....	73,604	66,749	---	6,855
Total herbicides.....	84,038	76,314	---	7,724
<u>Insecticides</u>				
Inorganic.....	7,651	7,095	15	541
Botanicals and biologicals.....	336	249	86	1
Synthetic organic.....	147,849	135,744	10,403	1,702
Other organic.....	160	96	63	1
Total insecticides.....	155,996	143,184	10,567	2,245
<u>Other Pesticides</u>				
Miticides.....	3,093	3,059	10	24
Fumigants.....	24,867	23,665	---	1,202
Defoliants and desiccants.....	16,129	11,906	---	4,223
Rodenticides <u>3/</u>	76	---	---	76
Growth regulators.....	2,566	2,566	---	---
Repellants.....	656	---	656	---
Total other pesticides.....	47,387	41,196	666	5,525
Total pesticides (not including petroleum) <u>4/</u>	457,500	426,637	14,059	16,804

1/ Includes all crops, pasture, range, and land in summer fallow.

2/ Includes fence rows, ditch banks and other non-crop usages.

3/ The enumeration was incomplete for rodenticides.

4/ About 313 million pounds of petroleum were used, primarily as active pesticidal ingredients, in addition to that used as adjuvants and diluents.

weight of the technical ingredients. Livestock accounted for 3 percent of the pesticides, and other uses accounted for 4 percent. Although over 10,000 individual commercial products are used as pesticides, these are mostly different formulations, concentrations, and combinations of about 400 technical or basic pesticide products. Fungicide products (to control plant fungus diseases), mostly sulfur for agricultural use, were concentrated on cotton, fruits, and vegetables, and amounted to 170 million pounds of technical materials. The herbicide most commonly used by farmers, 2,4-D, accounted for about 40 percent of the 84 million pounds of herbicides used in 1964. Nearly 40 percent of the herbicides was used on corn and small grain. Farm use of insecticides was 156 million pounds, about half of which was either toxaphene or DDT. More than 90 percent of the insecticides was used on crops, and over one-half was applied to cotton.

Research on the economics of pest control is underway in cooperation with the California, Missouri, Michigan, and Nebraska State Experiment Stations. The work in California, which has only recently been initiated, deals with costs and benefits to agriculture from the use of pesticides to combat red scale on citrus. It will compare the presently recommended control practices with that of minimizing the sum of treatment costs plus yield loss over a period of time by the use of simulation procedures.

In Missouri, data from the 1964 Nationwide Pesticide Survey are being used to estimate the contribution of pesticides to agricultural productivity and to identify the differences in productivity between regions, crops, and chemicals.

The work in Michigan and Nebraska is currently based on data from supplementary questionnaires related to corn and soybeans taken in a few States during the Pesticide and General Farm survey for 1966. These data are being tabulated and will be the basis for describing patterns of pesticide use, relationships of yield to pesticide use, differences between users and non-users, and for determining questions to be asked later on a nationwide basis for selected crops.

Preliminary tabulations of the extent of pesticide use for the Nebraska counties in the 1966 survey indicate that almost half of the corn and grain sorghum acreage was treated with herbicides, and nearly 60 percent of the corn acres was treated with insecticides or fungicides. Not many acres of wheat (about 1 percent) were treated for weed control. This is consistent with previous information, which showed that farmers generally used herbicides only once every 5 to 7 years to control weeds in winter wheat.

A chapter "Economic Principles of Pest Management" was prepared jointly by Division personnel in Michigan and Washington, D. C. for inclusion in a book "Principles of Insect Pest Management and Control" to be published by the National Academy of Science.

B. Economics of Feed Use and Feed-Livestock Relationships

Continuing research at the national level aims to measure effects of existing and new technology on feeding efficiency in livestock production and associated supply industries. Annual data on current feeding rates for all kinds and classes of livestock are developed. Significant trends in the feed-livestock industry are identified. Animal unit and feed unit series are related to total production of feeds and livestock.

Major 5-year revisions of annual State and national data were worked out on livestock numbers and feed consumption, and the several indexes based on them were revised. Revisions in totals of all animal units and livestock production units were relatively small. For example, the average revision in total grain-consuming animal units for all livestock and poultry for the 6 years 1959-64 was less than 0.3 percent, with no single year more than 0.8 percent. However, revisions in specific categories were more significant. Animal units of hens and pullets, cattle on feed, and other beef cattle were revised upward from less than 1 percent to about 7 percent; animal units of milk cows, other dairy cattle, and sheep were revised downward from less than 1 to 4 percent; and other classes of livestock were revised by smaller percentages.

A major study of the consumption of urea by beef cattle and milk cows represents the first phase of an analysis of the effect of emerging innovations on the feed-livestock industry. Two preliminary reports on urea consumption, one for beef cattle and the other for milk cows, are nearing completion. These present the results of a computer analysis of about 12,000 returns from 32 States on beef cattle, and 14,000 returns from 48 States on milk cows. Weighting factors were developed for adjusting sample totals for bias and for expanding them to represent the whole population.

The results indicate that more than 400 thousand tons of urea were consumed by cattle on feed and milk cows in the feeding year beginning October 1, 1965. This would be equivalent to about a fourth of the total protein concentrates fed to these animals in that year. About 57 percent of urea fed in the 1965 feeding year went to dairy cows and the balance essentially all to beef cattle. In this feeding year, the average price advantage of a corn-urea mixture to soybean meal was \$30 per ton. With a sorghum grain-urea mix, the price advantage over cottonseed meal averaged \$22. Thus, the upward price pressure on oilseed meal has been tempered by the substitution of urea in ruminant feed concentrates. Nonprotein-nitrogen feed carriers will continue to offer increasing competition to soybeans and cottonseed meal. Further increases in protein content of soybeans, use of high-lysine corn, and similar developments are also in prospect.

C. Economics of Farm Mechanization and Associated Techniques

No report.

D. Inventory and Analysis of Production Practices

Estimates of fertilizer use by crops and areas were constructed from 1964 Census data and other information. Similar analyses were completed earlier for 1954 and 1959. Data on fertilizer use from the 1964 Census of Agriculture, from special SRS surveys, and from SRS fertilizer consumption statistics for 1964 were brought together and collated. These data and appropriate forms were then sent to cooperating State groups of ERS, ARS, and State specialists, who made detailed estimates by crops of consumption of principal fertilizer nutrients. Results were consolidated in Washington and published in August 1967.

Processing was completed on two 48-State surveys: (1) Silage handling practices, 1963 and (2) corn growing practices, 1965. The silage report is in press. The manuscript on corn growing is being reviewed for publication. The major results were summarized in last year's progress report.

A national survey of machine use in 1965 shows a decline in the average annual hours farm tractors were used, from 450 in 1960 to 400 in 1965. An increase of 2.5 percent in the number of tractors with a decline of about 8 percent in crop acreage points up the decline in average hours of tractor use. However, the wheel tractor that was used the most on farms in 1965 averaged 500 hours; the second tractor in extent of use, 350 hours; and the remaining wheel tractors, only 160 hours. Use increased as the size of the tractor increased. Tractors under 35 belt horsepower averaged less than 400 hours; those of 70 horsepower and over averaged about 650 hours. Age is also an important factor affecting use of tractors. The average use of wheel tractors declines from about 500 hours for tractors up to and including 6 years of age, to around 250 hours when the tractor is 22 years old or older. Information on tractor use will be available by States and regions. In addition, the average acreage handled by major harvesting machines will be included in this report.

Preliminary results from a 48-State survey on crop drying and fuel use in 1966 show that about 25 percent of the 1966 production of corn for grain was dried artificially. Custom driers accounted for 5 percent of this. Farmers used liquid petroleum fuel for about 90 percent of the drying with their own equipment; other fuels or natural air were used for 10 percent. Where petroleum fuel was used, about 5 bushels of grain was dried per gallon of fuel.

The survey indicates gains in use of LP-gas and electricity for household heating with offsetting reductions in the use of coal and wood. Additional data to be summarized will show the extent of artificial drying of all crops, and quantities of fuel used for household heating. Also, using 1964 Census data on expenditures for petroleum fuels, total farm use of these fuels will be estimated for 1966.

E. Economics of Fertilizer Use and Crop Technology

Progress on studies of the economics of yield responses to fertilizers was limited by retirement of the project leader and other personnel shifts. However, the former project leader is now engaged in a related study sponsored by the Plant Food Institute under a memorandum of understanding with USDA. This study also has the active cooperation and participation of regional soil research committees in bringing together the most recent information on yield responses. Advances in associated technology have outdated earlier fertilizer response curves and the new curves show significant changes in level and shape.

F. Economics of Farm Structures and Materials Handling

Research on farm buildings, based on an empirical study of a sample of farms in 20 counties of north central Iowa, was completed and a report is being prepared. Results were summarized in last year's progress report.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Economics of Pesticide Use in Agriculture

Andrilenas, Paul A., Eichers, Theodore R., and Fox, Austin S. 1967. Farmers' expenditures for pesticides in 1964. Agr. Econ. Rpt. No. 106. 10 pp.

Delvo, Herman W., Tansom, Darwin, and Lane, Delbert. 1967. Methods of growing corn and grain sorghum in Nebraska -- 1964. Univ. of Nebr. Ext. Serv. EC-67-833. 22 pp.

B. Economics of Feed Use and Feed-Livestock Relationships

Allen, George C. and Hodges, Earl F. 1966. Feed consumed by various classes of livestock, by States, 1949-50 and 1959-60. Stat. Bul. No. 379. 50 pp.

Allen, George C. and Devers, Margaret. 1966. Supplement for 1966 to livestock-feed relationships, 1909-1965. Supplement for 1966 to Stat. Bul. No. 337. 26 pp.

C. Economics of Farm Mechanization and Associated Techniques

Strickler, Paul E. 1967. Machines and equipment on farms, with related data, 1964 and 1959. Stat. Bul. No. 401. 19 pp.

D. Inventory and Analysis of Production Practices

Elder, William A. and Van Arsdall, Roy N. 1967. Principal plant nutrients used on crops and pasture in Illinois. 1964 estimates and selected comparisons with 1954 and 1959 estimates. Dept. Agr. Econ. Agr. Expt. Sta. Univ. of Ill. AERR 86. 32 pp.

Ibach, D. B. and Adams, J. R. 1967. Fertilizer use in the United States by crops and areas. Stat. Bul. No. 408. 384 pp.

Irwin, George D. and Mannering, Jerry V. 1967. Fertilizer used on crops and pasture in Indiana: 1964 estimates with comparisons to 1959 and 1954. Purdue Univ. Agr. Expt. Sta. Res. Prog. Rpt. 307. 12 pp.

Schaffner, Leroy W. and Voelker, Stanley W. 1967. Statistics on fertilizer consumption in North Dakota, 1951 to 1966. Dept. Agr. Econ. Agr. Expt. Sta. N. Dak. State Univ. Agr. Econ. Rpt. 53. 48 pp.

Sharples, Jerry and Perrin, Richard. 1967. Fertilizer use in Iowa reaches record level. Iowa Farm Science 22(2), pp. 7-8.

E. Economics of Fertilizer Use and Crop Technology

None.

F. Economics of Farm Structures and Materials Handling

Scott, John T., Jr. and Heady, Earl O. 1966. Aggregate investment demand for farm buildings. A national, regional, and State time-series analysis. Iowa State Res. Bul. 545. 32 pp.

Scott, John T., Jr. and Heady, Earl O. 1967. Regional demand for farm buildings in the United States. Jour. Farm Econ. 49(1). pp. 184-198.

AREA NO. 8. FARM COSTS AND RETURNS

Problem. In this period of rapid change in American agriculture, it is important to have comprehensive, reliable, current, and historical data on representative or typical farms in major commercial farming areas of the United States. Physical and economic data needed include: Farm size, land use, livestock numbers, production, investment, prices received and quantities sold, prices paid and quantities purchased, and net returns. Such information is essential for intelligent policy and operating decisions by the agencies and industries serving agriculture and by farmers themselves.

USDA AND COOPERATIVE PROGRAM

Costs and returns by major types of farms is a continuing study of operations of typical or representative commercial farms to determine changes in size of farm, organization, investment, productivity, receipts, expenses, net farm income, physical inputs, farm output, prices received for products sold, and prices paid for goods and services used in production. Budgets are prepared annually to provide current information. Estimates for earlier years are revised as new information becomes available. Analyses are continually underway to show the effects of economic and technological changes on land, labor and capital requirements, production, production efficiency, and incomes of typical or representative commercial farms. Nearly all the work is done in Washington with informal cooperation with States where the studies are located. Formal cooperation is maintained with the Maine, Montana, Kentucky, and Tennessee Experiment Stations and is being developed with others.

A total of 6.7 Federal scientific man-years was devoted to all costs and returns work.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 38.0 scientist man-years is devoted to this area of research.

PROGRESS -- USDA AND COOPERATIVE PROGRAM

A. Costs and Returns by Major Types of Farms

Estimates for 1966 bring up to date the continuing series on costs and returns on typical commercial farms in 25 major producing areas of the United States. The report for 1966 covered 44 types of farms. Some minor revisions were made in 1966 because of enumerative surveys and availability of the 5-year revisions from SRS based on the 1964 U. S. Census of Agriculture. These data pertain to crop acreages, yields, production, disposition and numbers of livestock, and livestock production rates. None of

these revisions was substantial in nature. Revisions were made back to 1964 on the cotton farms in the Southern Piedmont and the Mississippi Delta to eliminate the cropper practice. This type of tenure arrangement has been rapidly declining and is no longer representative.

Work is continuing on the tabulation of samples of questionnaires from the 1964 U. S. Census of Agriculture. These samples have been completed for all the tobacco-type farms, most of the ranches, and are underway for the cotton farms.

Enumerative field surveys were made for wheat and grain sorghum farms in the Southern Plains. These surveys were undertaken to determine the extent of irrigation and associated costs on these types of farms in this particular area. Plans were completed for enumerative field surveys, to be taken in the late Fall, for cattle and sheep ranches in the Northern Plains livestock area and for wheat-pea and wheat-fallow farms in the Pacific Northwest.

In cooperation with the Kentucky and Tennessee Experiment Stations, estimates of costs and returns for 2 types of farms in the Kentucky-Tennessee Pennyroyal Area were completed. Results of these studies show that substantial gains have been made in production and net farm income per farm since the mid-1950's. Net farm income for 1964-66 averaged 64 percent higher than in 1954-56 on tobacco-beef farms; on tobacco-dairy farms, income was 60 percent above the 1954-56 average. Net farm production advanced 44 percent on tobacco-beef farms and 74 percent on tobacco-dairy farms during this period.

Personnel of the Maine, New Jersey and Delaware Experiment Stations cooperated on the poultry studies, and Montana, Utah, and New Mexico Station personnel cooperated on the ranch livestock studies. Considerable basic data were brought together jointly for the poultry area in Maine, and for the ranch livestock areas.

In 1966 net farm incomes were higher than in 1965 on 34 of the 44 types of farms, lower on 9, and about the same on 1 farm type. Increases in income ranged from 2 percent on small cotton farms in the Mississippi Delta to 84 percent on egg-producing farms in New Jersey. On farms that had increased net incomes, greater farm production or higher prices received for products sold, or both, were responsible for the higher incomes. Exceptions were the small and large-scale cotton farms in the Mississippi Delta, and irrigated cotton farms in the High Plains of Texas. Net farm production on each of these farms was lower than in 1965, and prices received averaged about the same or lower than in 1965. However, higher Government payments and lower operating expenses contributed to higher net incomes on these farms.

Net farm production was lower in 1966 than in 1965 on 8 of the 9 farms with lower net incomes, and 5 farm types also had lower prices for products sold. Declines in net income ranged from 1 percent to 75 percent. Cotton-specialty

crop farms in the San Joaquin Valley, California had the largest decrease because of the sharp drop from 1965 to 1966 in potato prices. However, net returns on these farms in 1965 were more than double the previous 5-year average.

Net farm production in 1966 was below 1965 on 25 of the 44 types of farms, about the same on 1, and greater on 18 farm types. Production declined on all cotton farms studied, except the Black Prairie of Texas, and on all wheat farms, except the wheat-fallow in the Pacific Northwest. Much of this was a result of Government programs related to commodities produced on these farms. Production was greater on the Black Prairie and wheat-fallow farms because of substantial increases in yields per acre. Prices received in 1966 were higher than in 1965 on 32 of the 44 types of farms, remained unchanged on 3, and decreased on 9 farm types. Prices declined on all cotton farms studied, except the peanut-cotton farms in the Southern Coastal Plains. The price of cotton in the United States decreased 27 percent in 1966; and for the cotton-type farms studied, the decreases ranged from 19 to 37 percent. On the peanut-cotton farms, increased prices received for cattle and hogs more than offset the decline in the cotton price.

Prices paid for goods and services used in production were higher in 1966 than in 1965 on 43 of the 44 farm types. These increases ranged from 1 to 10 percent. Lower prices paid for seed potatoes was the main reason for a 3-percent decrease in prices paid on cotton-specialty crop farms in the San Joaquin Valley.

In 1966, operating expenses continued to advance on most farms. Because of reduced cotton production, resulting from the Upland Cotton Program, costs associated with raising and harvesting cotton were lower, causing lower operating costs on all the cotton-type farms in 1966 compared with 1965.

The annual outlook issue of the Farm Cost Situation was published in November 1966, summarizing significant developments and outlook implications in the use and cost of the major farm production inputs. It also contained a summary of costs and returns on 7 types of farms selected to represent some of the major types of farms in the United States. This issue indicated a further rise in farm production expenses for 1967, including increases in expenses for fertilizer, pesticides, interest, taxes, insurance, and depreciation of capital items.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Costs and Returns by Major Types of Farms

Economic Research Service. 1966. The farm cost situation. 1967 Outlook issue. FCR-38. pp. 36-43.

Evans, J. A. and Nolan, D. 1967. Costs and returns, commercial cotton farms, 1966. FCR-53. 13 pp.

Goodsell, W. D., Gray, J. R., and Belfield, M. J. 1967. Costs and returns, western livestock ranches, 1966. FCR-45. 15 pp.

Goodsell, W. D. and others. 1967. Farm costs and returns, commercial farms, by type, size, and location. AIB 230 (Revised Oct. 1967). 108 pp.

Hole, E. and Cox, R. J. 1967. Costs and returns, commercial dairy farms, Northeast and Midwest, 1966. FCR-47. 9 pp.

Hurd, E. B. and Robinson, M. I. 1967. Costs and returns, commercial wheat farms, Pacific Northwest, Northern Plains, and Southern Plains, 1966. FCR-50. 18 pp.

Shugars, O. K., Bondurant, J. H., and Keller, L. H. 1967. Costs and returns, commercial tobacco-livestock farms, Pennyroyal area, Kentucky-Tennessee, 1965. Ky. Agr. Expt. Sta. Misc. Pub. 344. 8 pp.

Shugars, O. K., and Tippet, D. E. 1967. Costs and returns, commercial tobacco farms, Coastal Plain, North Carolina, 1966. FCR-46. 8 pp.

Shugars, O. K., Latimer, R. G., and Tippet, D. E. 1967. Costs and returns, commercial egg-producing farms, New Jersey, 1966. FCR-48. 2 pp.

Shugars, O. K., Bondurant, J. H., Keller, L. H., and Tippet, D. E. 1967. Costs and returns, commercial tobacco-livestock farms, Bluegrass area, Kentucky and Pennyroyal area, Kentucky-Tennessee, 1966. FCR-49. 12 pp.

Shugars, O. K., Reed, F. D., McAllister, W. T., and Tippet, D. E. 1967. Costs and returns, commercial broiler farms, Maine, Delmarva, and Georgia, 1966. FCR-51. 13 pp.

Strand, E. G. 1967. Costs and returns, commercial Corn Belt farms, 1966. FCR-52. 10 pp.

AREA NO. 9. FARM LABOR UTILIZATION AND PRODUCTIVITY

Problem. The utilization of human effort in farm production has changed greatly in recent decades and will likely change even more rapidly in the years to come. Technological and other economic developments increase the productivity of individual workers and make possible a decrease in the number of persons engaged in farmwork. But these developments require higher levels of skill and knowledge on the part of the persons continuing to do farmwork, while forcing other workers to seek nonfarm employment. At the same time, the increasing attractiveness of nonfarm jobs together with various social and economic changes exert upward pressures on earnings and perquisites in many types of farm employment. Because of the many economic, social, and other changes that affect the utilization of human effort in farm production, a better understanding of these changes is needed to assist in planning for and guiding the human and economic adjustments involved.

USDA AND COOPERATIVE PROGRAM

Work on farm labor requirements and use is carried on as a continuing program aimed at keeping abreast of farm labor used, nationally and by regions, in total and by major enterprises. Estimates of man-hours of farmwork are prepared annually, based on pertinent secondary data and, when necessary, by field surveys. This series of estimates, going back to 1910, give a comprehensive statistical picture of what has happened to farm labor requirements over the years.

A continuing program of research on farm labor productivity and efficiency is conducted. It provides annual indexes of farm production per man-hour, with breakdowns by regions and by major commodities. The series of estimates provide comprehensive measures of farm labor productivity over the years. Periodically, analyses are made of the past and projected future effects of technological and other developments on production per man-hour and on quantity of labor input used.

In a continuing program, studies are made of the effects of rising labor costs on demand for labor, farm production, adoption of new technology, and on changing structure of agriculture. Unit farm labor costs are increasing rapidly as the result of a number of different factors, including such Federal legislation as a minimum wage and social security, and in some States by such legislation as workmen's compensation, unemployment insurance, and make-up pay. Also, increased competition from the nonfarm sector for workers as the economy operates at nearly full employment, rising skill levels needed by farmworkers to operate more complex labor-saving equipment, higher perquisites and incentive payments, and attempts to reduce seasonal employment to provide more continuous work periods, have been major contributors to rising unit farm labor costs. Current research includes

nationwide surveys of labor and related data by such farm characteristics as type, size, and economic class.

Cooperative research was carried on with the California, Maine, Michigan, Oregon, Purdue, and Washington Experiment Stations.

A total of 3.4 Federal scientific man-years is devoted to this research area, distributed as follows: Farm labor requirements and use, 0.8 man-year; farm labor productivity and efficiency, 0.2 man-year; and economics of farm labor utilization, 2.4 man-years.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 8.4 scientist man-years is devoted to this area of research.

PROGRESS -- USDA AND COOPERATIVE PROGRAM

A. Farm Labor Requirements and Use

The continuing research on labor requirements and use in farm production indicated that labor used on U. S. farms in 1966 reached a new low of about 7.5 billion man-hours, 5 percent less than in 1965. Labor devoted to the care of all crops dropped more than for livestock. Requirements for cotton production declined 36 percent, brought about by additional mechanization on a reduced acreage. Man-hours used for livestock declined about 5 percent, with requirements for milk cows down about 9 percent.

Farmwork required fewer man-hours in 1966 than in 1965 in all parts of the country except in the Pacific region where an increase of nearly 2 percent occurred. The decrease was 11 percent in the Southern Plains and 10 percent in the Delta States, reflecting chiefly the decline in labor requirements for cotton. In the other regions, the drop in man-hours was more moderate, ranging to only 3 percent in the Southeast region.

B. Farm Labor Productivity and Efficiency

The continuing research on farm labor productivity and efficiency shows that farm output per man-hour rose almost 4 percent from 1965 to 1966, to 161 percent of the 1957-59 average. The increase for livestock as a whole was 2.3 times the gain for crops. Production per man-hour of livestock and livestock products increased about 7 percent from 1965 to 1966. Since 1957-59, the greatest gain in farm output per man-hour has occurred in the Mississippi Delta States. In 1966 in this area, it was 197 percent of the 1957-59 average. In the Pacific region, where fruits and vegetables are important, the increase in labor productivity has been smallest because these crops are more difficult to mechanize.

There were 5.2 million farmworkers in 1966, and each, on the average, produced enough food, fiber, and other farm products to supply himself and

39 other consumers. In 1960, each farmworker produced enough farm products for himself and 25 other consumers. Most of the consumers were U. S. residents, but in 1966, about 15 percent were the citizens of foreign countries who were supplied through exports from the United States. The gain in persons supplied per farmworker has resulted from greater application of modern technology both on and off the farm, including the transfer of some jobs from farm to nonfarm-workers.

C. Economics of Farm Labor Utilization

In a cooperative study with the Maine Experiment Station, major emphasis focused on labor issues relating to potato production and other crop enterprises in Aroostock County, Maine. Numerous changes in labor utilization have taken place in potato production in recent years. Among these has been a reduction in number of Canadians available for harvest operations. Analyses were made of employment patterns of Canadians in the northern, central, and southern areas of the county. About 70 percent are employed in the central area, 26 percent in the northern, and the remaining 4 percent in the southern, area. Wage rates are the same as those paid to domestic workers for comparable jobs. Another change that is taking place is the increased skill required of employees. This has been brought about by the adoption of newer types and larger sizes of specialized farming equipment not only for potatoes but also for sugarbeets and peas. About 720 harvesters were used for harvesting around a third of last year's potato crop. In 1960 about 150 machines of a smaller size were in use. Descriptive information on changes underway has been useful to personnel who are concerned with problems in the area. A report appraising the changes is underway.

In cooperation with Michigan Experiment Station, a project to study demand for labor on Michigan fruit farms continued. About 250 farm schedules were taken on a sample of fruit farms in 19 western Michigan counties. These are being analyzed to determine amount, kinds, and costs of labor used, and the extent farmers have been able to reduce labor through increased mechanization. Effort is also being directed to determine the effectiveness of new and proposed machines to reduce labor requirements for harvesting fruit and other labor-intensive crops.

During the past year a survey was taken of 80 cash crop farms in the Sacramento, California, canning tomato area. Costs and returns for each farm in the sample are being analyzed in an attempt to identify those social and economic characteristics which are significantly related to firm efficiency and/or adjustment performance.

A preliminary report based on an analysis of a 30-farm subsample was presented at the WFEA summer meetings in Las Cruces, New Mexico. Preliminary findings indicate that the forces in play over the time period (1958-65) have worked to the advantage of larger operators (operating over approximately 600 acres). These larger farms have accounted for the bulk of

acreage increases, and have adopted new practices and innovations more rapidly than their smaller counterparts. The aggregate farms in the subsample were using 30 percent less labor and 19 percent more capital on a per acre basis during 1965 as compared to 1958. Capital-labor substitution has been, and will continue to be, an important part of the adjustments taking place.

A study of factors affecting the current and prospective demand for hired farm labor in the States of Washington and Oregon has been initiated in cooperation with the Experiment Stations of these States. Farm schedules are being taken to study the labor situation for caneberry producers.

A project continues in cooperation with Purdue University to investigate the impact of technological change on the demand for and use of farm labor with special reference to factor returns and to the labor skills needed in farming. A national model has been formulated which distinguishes among the types of structural effects technological change may have on the derived demand for agricultural labor.

D. Economic Relationships Between Farm Operators and Hired Farmworkers

No report.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Farm Labor Requirements and Use

Farm Production Economics Division. 1967. Man-hours of labor used for farmwork, by groups of livestock and crops, for each farm production region, 1950-66. Stat. Bul. 233, Sup. III. 7 pp.

B. Farm Labor Productivity and Efficiency

Farm Production Economics Division. 1967. Changes in farm production and efficiency. Stat. Bul. 233, Revised. 17 pp.

Farm Production Economics Division. 1967. Index numbers of farm production per man-hour, by groups of livestock and crops, for each farm production region, 1950-66. Stat. Bul. 233, Sup. IV. 7 pp.

C. Economics of Farm Labor Utilization

None.

D. Economic Relationships Between Farm Operators and Hired Farmworkers

Conklin, M. J. and McElroy, R. E. 1966. A survey of migrant farmworkers in Oregon. Oreg. Agr. Expt. Sta. Bul. 602. 39 pp.

Line Project Check List -- Reporting Year Oct. 1, 1966 to Oct. 1, 1967

Work & Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Proj. Incl. in	
			Summary of Progress	Area and Subheading
FE 1 FE 1-10	Farm capital, credit, and financial condition Financial management of farm firms	Washington, D.C., Carbondale, Ill., Gainesville, Fla., Columbus, Ohio, E. Lansing, Mich., Lincoln, Nebr., Pullman, Wash., Urbana, Ill.	Yes	4-C
FE 1-11	Maintenance and improvement of farm credit statistics and analysis of trends	Washington, D.C.	Yes	4-B
FE 1-12	The changing farm financial condition and its relation to the structure of agriculture	Washington, D.C.	Yes	4-A
FE 1-13	Factors affecting the cost, terms, availability and condition of credit and capital for farmers and rural areas	Washington, D.C., & Columbia, Mo.	Yes	4-B
FE 2 FE 2-1 (Rev.)	Farmland values and valuation Current developments in the farm real estate situation	Washington, D.C.	Yes	6-A&B
FE 2-2 (Rev.)	Annual estimates and analysis of trends in farm real estate rentals	Washington, D.C.	Yes	6-C
FE 3 FE 3-4	Agricultural risks and insurance Risk and risk-bearing in selected agricultural areas	Washington, D.C., Bozeman, Mont., Manhattan, Kans., and University Park, Pa.	Yes	5-D
FE 3-5	Measurement and analysis of farm losses and farm insurance	Washington, D.C.	Yes	5-A,B&C
FE 9 FE 9-2 (Rev.)	Agricultural adjustments and production response A study of farm organization and management problems in southeastern and southwestern Minnesota	St. Paul, Minn.	Yes	2-A
FE 9-5 (Rev.)	Economics of adjustments in beef production in the west	Tucson, Ariz., Ft. Collins, Colo., Lincoln, Nebr., & Corvallis, Oreg.	Yes	1-G
FE 9-7 (Rev.)	Economics of adjustments in cotton producing areas in California	Davis, Calif.	Yes	1-D
FE 9-9 (Rev.)	An economic appraisal of adjustment opportunities in southern rice producing areas	Fayetteville, Ark., Baton Rouge, La., College Station, Tex., & Davis, Calif.	Yes	1-F
FE 9-11	Adjustments in hog and beef cattle production in the Corn Belt to meet changing conditions -- FE coopera- tion in Regional Project NC-54**	Washington, D.C., & selected States	Yes	1-G
FE 9-14	Economic appraisal of adjustments in Corn Belt farming to meet changing conditions	Washington, D.C., & selected States	Yes	1-B&G

* Initiated during reporting year. ** Discontinued during reporting year.

Line Project Check List -- Reporting Year Oct. 1, 1966 to Oct. 1, 1967

Work & Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Proj. Incl. in	
			Summary of Progress	Area and Subheading
FE 9-15	Economic appraisal of adjustments in dairy farming in the Lake States and adjoining areas to meet changing conditions	Washington, D.C., & selected States	Yes	1-C
FE 9-16	Economic appraisal of adjustments in dairy farming in the Northeast to meet changing conditions	Washington, D.C., & selected States	Yes	1-C
FE 9-17	Economics of adjustments on farms and production response in the Northern Plains wheat producing region	Washington, D.C., & selected States	Yes	1-E
FE 9-18	Production economics studies of agricultural production control programs	Washington, D.C., & selected States	Yes	1-H
FE 9-19	Analysis of agricultural production response	Washington, D.C., & selected States	Yes	1-B
FE 9-20	Economic appraisals of emerging technological developments in southern agriculture	Washington, D.C., & selected States	Yes	1-I
FE 9-21	An economic appraisal of emerging crop, livestock, and poultry technologies in the northern region	Washington, D.C., & selected States	Yes	2-A
FE 9-22	An economic appraisal of farming adjustment opportunities in the southeastern region to meet changing conditions	Washington, D.C., & selected States	Yes	1-D
FE 9-23	Economics of adjustments on farms and production response in the Southern Plains wheat producing region	Washington, D.C., & selected States	Yes	1-E
FE 9-24	Economics of adjustments on farms and production response in the Pacific Northwest wheat producing region	Washington, D.C., & selected States	Yes	1-E
FE 9-25	Farm management under conditions of variable output in the Great Plains	Bozeman, Mont.	No.	---
FE 9-27	An economic appraisal of farming adjustment opportunities in the South Central region to meet changing conditions	Washington, D.C., & selected States	Yes	1-D
FE 9-28	Economic appraisal of regional adjustments in agricultural production and resource use to meet changing demand and technology	Ames, Iowa	Yes	1-B
FE 9-30	Economic analysis of production problems and adjustments on western range-livestock ranches	Washington, D.C., & selected States	Yes	1-G
FE 9-31	Appraisal of year-to-year changes in the cost of producing cotton in the U. S.	Washington, D.C., & selected States	Yes	1-I
FE 10	Economics of farm size			
FE 10-1 (Rev.)	Economic appraisal of minimum farm resources needed for specified farm income levels	Washington, D.C., & selected States	No	---
FE 10-2 (Rev.)	Classification and analysis of kinds and sizes of farms	Washington, D.C.	Yes	3-B
FE 10-4	Optimum and feasible adjustments in size and number of farms in selected areas	Washington, D.C., & selected States	Yes	3-B

* Initiated during reporting year. ** Discontinued during reporting year.

Line Project Check List -- Reporting Year Oct. 1, 1966 to Oct. 1, 1967

Work & Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Proj. Incl. in	
			Summary of Progress	Area and Subheading
FE 11	Economics of farm labor resources and utilization			
FE 11-6	Annual estimates and analysis of labor requirements and productivity in U. S. agriculture	Washington, D.C.	Yes	9-A&B
FE 11-7	Labor and capital use in the production of selected crops and livestock	Washington, D.C., & selected States	Yes	9-C
FE 11-8	Demand for and use of farm labor as affected by technological change and changing economic conditions*	Washington, D.C., & Lafayette, Ind.	Yes	9-C
FE 12	Economics of technological changes in farming			
FE 12-1 (Rev.)	Measurement and analysis of progress in farm mechanization	Washington, D.C.	No	---
FE 12-2 (Rev.)	National survey and analysis of selected farm production practices	Washington, D.C.	Yes	7-D
FE 12-3 (Rev.)	Annual estimates of feed consumption and animal units in the U. S. by class and species of livestock	Washington, D.C.	Yes	7-B
FE 12-6	Economic interpretation of yield response to fertilizer and associated technology	Washington, D.C.	Yes	7-E
FE 12-7 (C)	The farm demand for fertilizer, machinery, and structures	Washington, D.C. & Ames, Iowa	Yes	7-F
FE 12-9	Economic evaluation of pasture production	Washington, D.C.	No	---
FE 12-10	Economics of pesticide use in agriculture	Washington, D.C., Davis, Calif., Columbia, Mo., Lincoln, Nebr., & E. Lansing, Mich.	Yes	7-A
FE 12-11	Estimates of principal plant nutrients used on specified crops - 1964	Washington, D.C.	Yes	7-D
FE 12-12	Economic impact of structural changes in the livestock-feed industry	Washington, D.C.	Yes	7-B
FE-ME 1 (Rev.) (FE 12-13)	Changing structure and performance of the American agricultural chemical industry and its coordination with farms	Washington, D.C.	Yes	3-A
FE 13	Farm output and resource productivity			
FE 13-3	Appraisal of the influence of weather on crop yields and production	Washington, D.C., Ames, Iowa, & Corvallis, Oreg.	Yes	1-A
FE 13-4	Appraisal of farm production prospects and resource needs	Washington, D.C.	Yes	1-A
FE 13-5	Measurement and analyses of farm output and resources used	Washington, D.C.	Yes	1-A
FE 14	Farm costs and returns			
FE 14-1 (Rev.)	Annual estimates and analyses of changes in costs, returns, and farm organization on commercial family-operated farms by type and size	Washington, D.C.	Yes	8-A
FE 14-2	Preparation of "Farm Cost Situation" reports	Washington, D.C.	Yes	8-A
FE 14-3 (Rev.)	Costs and returns on commercial poultry farms (egg and broiler) in the Northeastern, Middle Atlantic, and Southeastern States**	Washington, D.C.	Yes	8-A

* Initiated during reporting year. ** Discontinued during reporting year.